5 ENVIRONMENTAL CONSEQUENCES

This chapter forms the scientific and analytic basis for comparing the effects of the potential placement alternatives considered in this PEIS. It presents information about the generally known impacts of dredged material placement at the various alternative types (Section 5.1). Environmental and socioeconomic impacts that could result from taking no action (Section 5.2) and from placement of dredged material at each of the potential alternative sites (Section 5.3) are also considered. In addition, cumulative impacts of past, current, and future actions are described, as well as possible mitigation steps to avoid, minimize, or reduce potential impacts.

This PEIS evaluates and compares the direct, indirect, and cumulative impacts from a qualitative perspective, commensurate with the programmatic level of detail within which this document was developed.

5.1 KNOWN IMPACTS FROM DREDGED MATERIAL PLACEMENT

There are several options for the placement of dredged material removed from USACE navigation projects within the Long Island Sound study area: confined and unconfined open ocean placement, confined nearshore placement, landfill placement, and beneficial use. While the compatibility of dredged material for the various placement options will need to be determined on a project-by-project basis, the options that would have the lowest impact and greatest benefit are likely to be preferred. Over the past decade, several events have had devastating and costly consequences for Long Island Sound coastal communities and habitats. These events include Hurricanes Sandy and Irene. The increased storm frequency and sea level rise associated with climate change also threaten coastal communities and habitats. Restoration of the coastal habitats would benefit much of Long Island Sound's wildlife and fisheries species, and the livelihoods of the people in these coastal areas.

Comparisons of the direct and indirect impacts for the alternative types that may be used by USACE and other Federal agency navigation projects in Long Island Sound are presented in this section. Direct impacts are those effects that are caused by the action and occur at the same time and place (Section 1508.8(a) of 40 CFR Parts 1500-1508). For example, beneficial use of dredged material could directly convert acres of nearshore habitat to beach or island habitat. Indirect impacts are those effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (Section 1508.8(b) of 40 CFR Parts 1500-1508). An example of this would be sedimentation that indirectly results from changes in sediment supply or transport by littoral currents.

This section discusses established, known impacts from dredged material placement by alternative type, based on information presented in the Affected Environment chapter (Chapter 4) of this PEIS and other established documents. Because this is a programmatic assessment, general impacts are addressed by alternative types that may be utilized by USACE and other Federal agency navigation projects within the Long Island Sound study area, rather than on a site-specific or project-specific basis. A summary table of resource impacts by alternative type (USACE, 2015a) lists the resources that may be impacted through the placement of dredged material. Resources were grouped into four categories: physical, environmental, infrastructure, and cultural resources. This grouping was developed by USACE in several of its background reports written to support the Long Island Sound DMMP. The environmental resources impacted will depend on the type of alternative. Resources that were not relevant for a given alternative type (such as terrestrial wildlife at open-water sites) were identified as "Not Applicable." Where resources were relevant, resource impacts were assessed and summarized as "Yes," "Potential," or "No." In addition, anticipated positive impacts, or benefits, through the use of dredged material by each alternative type are summarized for each group of resources.

Socioeconomic impacts were also assessed for each alternative type. Socioeconomic impacts were projected based on parameters identified in Section 122, River and Harbor and Flood Control Act of 1970, P.L. 91-611. These parameters are as follows:

- Destruction/disruption of man-made/natural resources
- Aesthetic values
- Community cohesion
- Availability of public facilities and services
- Employment effects
- Tax and property value losses
- Injurious displacement of people, businesses, and farms
- Disruption of desirable community and regional growth

Because the impacts are assigned to the alternative *type* of dredged material placement activity rather to specific dredged material placement sites, impacts are generalized. Positive and negative impacts or consequences are projected and may be short- or long-term in duration depending, in part, upon the material placement schedules for alternative types. The following sections describe these general impacts to physical, environmental, infrastructure, cultural, and socioeconomic resources by alternative type.

5.1.1 Open-Water Placement Impacts

The Open-Water Alternative would involve the placement of dredged material in the aquatic environment using a variety of equipment (Chapter 3). Pipeline or hydraulic dredges, hopper dredges, and bottom-release barges and scows may be used to store and/or transport material for placement, depending upon the location of the placement site in relation to the dredging location and the characteristics of the dredged material. Each release of dredged material would occur as a discrete discharge of material, which may have impacts to the resources present.

Unconfined Open-Water Placement

Physical Impacts

During placement at designated sites, dredged material released from a barge physically impacts the water column and then the seafloor over a limited area. Most of the sediment falls rapidly to the seafloor, but approximately 1% to 5% of the discharged sediment remains suspended in a plume and then settles to the seafloor (Ruggaber & Adams (2000); Tavolaro (1984); USACE, (1986)). Field studies have confirmed that these plumes are transient and have short-term (i.e., hours in duration) impacts on water quality (Dragos & Lewis (1993); Dragos & Peven (1994); SAIC (2004); SAIC (2005a); SAIC (2005b); ENSR (2008)).

Dredged material placed in open water may result in physical changes to the seafloor, altering the grain size and/or TOC if the sediment properties of the dredged material are different from the ambient seafloor sediments. Dredged material from the Long Island Sound region generally has consisted of very fine sand to silt and clay that has filled in navigational channels in harbor regions and medium to fine sand from some outer-harbor entrance channels. Circular ring structures and pits have been evident in acoustic survey images at several of these sites and indicate individual placement event impacts (ENSR, 2007).

Dredged material is typically placed at a target area buoy or precision navigation coordinates. The overlap of multiple dredged material placement events at a designated location ultimately builds discernible, low-profile mounds within a placement site, altering the topography of the area. Multiple placement events may result in sediment accumulations several inches to several feet high with a radius of about 70 to 700 ft. The accumulation of dredged material thus has a physical impact by decreasing the relative water depth above the dredged material placement site, which has the potential to modify ambient currents and sediment transport. However, each site has been selected, and is managed, to control the number and elevation of mounds created to avoid interferences with shipping and navigation, as well as to avoid sediment transport and major alterations of bottom currents and dynamics. The only exception to this practice is the one dispersive site, the CSDS, which is located in a region of sand transport and is managed to allow dispersion of material placed at the site. Mound formation at the placement sites has not been found to interfere with regional flow patterns and transport or substantially impact bottom currents or other physical dynamics in Long Island Sound (ENSR, 2007).

The most prevalent process occurring right after placement is reconsolidation of the sediment due to the weight of the material in the mound. As a result of this settling process, a portion of the water trapped in the dredged material is expelled, reducing the mound's total volume. The amount of water released and rate of this process depends on the properties of the sediment, including grain size and water content. Most consolidation has been found to occur within the first year or two of placement (Silva, et al., 1994).

In addition, once deposited on the seafloor, dredged material may potentially physically impact the surrounding area through potential sediment transport from currents, storm activity, or disturbance by fishing activity. These impacts have been observed to be minimal at placement sites studied under the DAMOS program (Fredette & French, 2004). Monitoring has documented major sediment transport of placed sediments to surrounding areas only at CSDS, where hydrodynamic conditions transport ambient sediments as well (ENSR, 2005a). At the non-dispersive sites (WLDS, CLDS, and NLDS), tidal current regimes are insufficient to significantly erode deposited dredged material (Fredette & French, 2004). Episodic conditions (e.g., when spring tidal currents are amplified by wind events) have resulted in resuspension and transport of only small amounts of fine-grained sediments. Where erosion does winnow fine sediments from surface sediment, lag deposits of coarser sediment and shell deposit have been observed to armor the remaining sediment from erosion (Fredette & French (2004); AECOM (2009); Carey, et al. (2012)). Studies over the last 35 years, including those of the DAMOS program, have documented the general stability of dredged material mounds by recording bathymetry before and after active placement operations, and periodically thereafter (EPA (2004); ENSR (2007); Carey, et al. (2015)).

Environmental Impacts

For over 40 years, studies and monitoring efforts have been conducted in Long Island Sound to understand the consequences of dredged material placement to benthic habitats and to the local food web (Wolf, et al. (2012), Fredette & French, (2004), Valente (2004)). The type and extent of impacts depend on the characteristics of both the dredged material and the habitat at the placement site (Bolam, et al., 2006). Although short-term impacts and long-term changes in habitat due to sediment type and elevation of the seafloor have occurred, there is no evidence of long-term effects on benthic processes or habitat conditions (Germano, et al. (2011); Lopez, et al. (2014)).

One of the key biological impacts is the burial of benthic invertebrates where dredged material is deposited. Sediment type, sediment depth, burial duration, temperature, and adaptive features such as an organism's ability to burrow and to survive can affect the ability of organisms to migrate to normal depths of habitation. Benthic disturbance from dredged material placement in Long Island Sound has direct, immediate effects on sessile epifauna and infauna (Germano, et al. (1994), (2011)). Sediment accumulations greater than 6 inches are expected to smother most benthic infauna (Lopez, et al., 2014). Large decapod crustaceans (i.e., cancer crabs, shrimp species, lobster) are able to penetrate deeply into the sediment, which provides them with mechanisms that enable them to survive some burial. Other strong deposit feeders can withstand burial of 4 inches or more (Jackson & James (1979); Bellchambers & Richardson (1995)), while 0.4 inch of sediment can kill attached epifaunal suspension feeders (Kranz, 1974). The greatest impacts from burial occur in the central mound area, where multiple deposits result in the thickest amounts of placed sediment (Germano, et al., 1994). The burial on benthic invertebrate populations is typically a short-term impact, because infauna rapidly recolonize the freshly placed, organic-rich material.

Additional short-term impacts of placement may occur. Small surface-dwelling animals (e.g., some amphipod and polychaete species) may be dislodged and transported to the outer region of the deposit with water and sediment movement. The sediment plume may temporarily interfere with benthic feeding and respiration in the water column.

The physical nature of seafloor sediments defines the type of habitat that is available for benthic organisms to colonize, and thus the types of organisms and benthic community that can live and thrive on the mounds. Potential long-term impacts may include changes in benthic community composition that result from potential alterations in sediment grain size and TOC as well as alterations in seafloor elevation.

The rate of benthic recolonization and the recovery rate of dredged material placement mounds have been intensively studied in New England and other marine environments. SPI has been used since 1982 to test the model of benthic succession in response to physical disturbance from dredged material placement (Rhoads, et al. (1978); Germano, et al. (2011)) (additional information is presented in Section 4.8 and Figure 4-30). SPI depicts a vertical cross section of sediment up to 8 inches deep, providing visual evidence of organism-sediment interactions and the sediment-water interface. A process-based model (Rhoads and Germano (1982), (1986)) has been used to interpret the ecological effects of dredged material in Long Island Sound (Germano, et al., 1994) and minimize the impacts of disturbance through tiered monitoring (Fredette (Fredette, 1998); Fredette & French (2004)). Initially, there may be an absence of visible species, called Stage 0. According to the successional model (Rhoads & Germano, 1986), within a few days to weeks of physical disturbance or deposition of dredged material, Stage 1 organisms (small, tube-dwelling surface deposit feeders) settle on the surface sediment. Stage 2 infaunal deposit feeders gradually replace the Stage 1 organisms, and then larger Stage 3 infaunal deposit feeders (which feed in a head-down orientation, creating distinctive feeding voids) inhabit the sediment (Germano, et al., 2011). The dredged material characteristics and the benthic community composition and structure affect the rate of succession, which typically results in a deepening of the bioturbated mixed sediment layer and convergence with the surrounding benthic habitat conditions (Zajac, 2001). The successional model has not been developed for coarse sediments or cohesive clays (Germano, et al., 2011). The timing of disturbance relative to seasonal pulses of settlement and growth of larvae also strongly influence the nature and rate of recolonization (Zajac & Whitlatch (1982); Wilber, et al. (2007)). The establishment of a mature community may take months to years to complete and depends in part on whether additional physical disturbances interrupt the successional process.

DAMOS and other programs have repeatedly documented recolonization of mound surfaces with surface and infaunal assemblages typical of the sediments surrounding the placement site (Germano, et al., 2011). The outer region of the dredged material mound, known as the apron, can introduce higher organic sediment content than the ambient sediment, supplying a new food source for deposit feeders (Lopez, et al., 2014). The apron has been found to extend 300 ft to 1,600 ft beyond the acoustically detectable margin of the mound (multibeam surveys can reliably detect accumulations greater than 4 inches, and single-beam fathometers can detect greater than 8 inches of accumulated sediment (Fredette & French (2004); Carey, et al. (2012)). Within months, high settlement densities of opportunist species (polychaetes, amphipods, bivalves, and meiofauna) occur, and rapid bioturbation that mixes the deposit with seafloor sediments usually makes the apron area indistinguishable (Germano, et al. (2011); Lopez, et al. (2014)). These studies also have found that the recovery of the mound apex, which is generally the most disturbed area, tends to be slower than at the mound apron, where deposited sediments are thinner and burial impacts are fewer. Mounds that have been in place for two or more years consistently support mature benthic assemblages that are similar to reference areas outside of the open-water placement site and are stable over time.

Both short- and long-term impacts to shellfish could potentially occur from the placement of dredged material in Long Island Sound. While these impacts can range from acute mortality associated with the burial of shellfish to the temporary displacement of shellfish or reduced filtration rates during periods of high turbidity, direct impacts to these organisms from the placement of dredged material are generally limited to the footprint of the placement mound (EPA, 2004). The American lobster is the primary shellfish resource inhabiting the designated placement sites. As dredging windows restrict placement during vulnerable life stages of lobsters, burial impacts are expected to have limited short-term impacts on shellfish resources (EPA, 2004). Studies of lobster abundance at the RISDS showed declines in lobster abundance in the region as a whole, but 1.5 years after the placement of dredged material, the lobster population abundance at the site did not appear to have experienced significant adverse impacts (Valente, et al. (2004)). Potential long-term impacts include the potential alteration of the community as a result of changes to habitat type (grain size) and food resources.

Benthic community and productivity changes may in turn affect higher trophic levels (a feeding stratum in the food chain) by providing more or less prey at a given location or prey that is more or less suitable for a variety of species. Erosion of silts and clays and sediment changes also may provide positive attributes, such as armoring the surface against further erosion and creating microhabitats within the placement site that provide greater variability in benthic habitat, leading to continued, if not greater, utilization of the area by fish and shellfish (SAIC, 2001a).

Abrupt changes in topography or bottom type can create rich habitat for finfish and motile shellfishlike lobster, and artificial structures (artificial reefs) can also provide such typically rich habitat (Ries & Sisk, (2004); Macreadie, et al., (2010); Macreadie, et al. (2012)). Clark & Kasal (1994) explored the concept of stable dredged material mounds providing substantial fisheries resource benefits as a long-term management objective for dredged material placement. Anecdotal fishery reports have indicated that mounds and berms create conditions conducive to enhanced fisheries production. Few definitive scientific studies have been conducted to support this claim, although limited data from the Rockland Disposal Site off the coast of Maine suggest that the placement mound supports an active population of megafauna (SAIC, 2001b). Lobstermen from Long Island Sound repeatedly and consistently report that lobstering is more productive near active open-water placement sites (EPA, 2004). Lobster gear is frequently encountered during monitoring surveys. Interviews with fishermen and available reports also confirm that fishing in the vicinity of mounds is similar to or better than areas away from the mounds.

There is potential for short-term impacts to plankton from dredged material entrainment and sediment plumes in the water column. Most of the discharged dredged material quickly falls to the seafloor, which entrains a small volume of planktonic organisms (e.g., phytoplankton, zooplankton, and larval stages of fish and invertebrates) and displaces others with the movement of water. Increased turbidity resulting from discharged dredged material would temporarily alter water quality; this has short-term impacts on plankton which could be detrimental or beneficial, depending on the species and composition of the dredged material. The suspended solids may reduce light penetration in limited spatial areas, which may temporarily reduce photosynthesis (Kraus (1991); Dragos & Lewis (1993); Dragos & Peven (1994)). Most phytoplankton productivity occurs in surface waters above the most turbid portion of the sediment plumes that typically occur closer to the seafloor at open-water sites (ENSR, 2008).

Potential intermittent, short-term impacts to fish include the direct destruction and burial of bottom-dwelling species and disturbance of fish throughout the water column within the localized area. Due to their mobility, most fish would be expected to move out of a dredged material burial area. The sediment plume following placement would also have potential short-term water quality impacts that may also have indirect impacts on fish by temporarily altering certain finfish behaviors, such as migration, spawning, foraging, schooling, and predator evasion (O'Connor, 1991). Increased turbidity has also been associated with potential gill abrasion and respiratory damage (Saila, et al. (1971); Wilber & Clark (2001)). However, fish species may avoid placement areas during periods of high turbidity (Packer, et al., 1999).

Sediment characteristics and the life stage of species affect how sensitive species are to suspended sediment, with egg and larval stages tending to be the most sensitive (Johnson, et al., (2008); Wilber & Clark (2001)). However, these impacts are limited both in duration and spatially due to the short time needed for dredged material to reach the bottom (Kraus (1991); Dragos & Lewis (1993); Dragos & Peven (1994)). Saila, et al. (1971) also point out that "aquatic animals are able to tolerate high concentrations of suspended sediments for short periods." Since the tolerance level for suspended solids is high in shallow and mid-depth coastal waters, and fish and lobster may experience major changes in turbidity during storms, Saila, et al. (1971) conclude that mortality due to elevated sediment concentrations in the water column resulting from dredged material placement is not likely. Following these turbid periods, finfish and shellfish may be drawn back to a placement site by irregularities in the substrate and the presence of new material containing infaunal organisms and other forage (EPA, 2004).

Physical changes to sediment characteristics would potentially result in habitat impairment or enhancement, depending on the type of change and the benthic response. All of Long Island Sound is mapped as EFH, and there are three listed endangered fish species that potentially could occur at the unconfined open-water placement alternative sites. Previously, NMFS and USFWS concurred with the findings of the 2004 Final EIS designation of the WLDS and CLDS stating that the dredged material placement at these sites is not likely to adversely affect listed species or EFH (EPA, 2005).

Unconfined open-water placement has the potential to impact marine mammals and reptiles, which includes five endangered or threatened species of both whales and sea turtles, directly by vessel strikes or by harassment during placement due to noise and sediment discharge. Temporary sediment plumes may also cause avoidance of the local area. USFWS noted in the designation of CLDS and WLDS that "no habitat in the project impact area is currently designated or proposed 'critical habitat' in accordance with provisions of the Endangered Species Act (87 Stat. 884 as amended; 16 U.S. C. 1532 et seq.)." About 20 species of marine mammals and reptiles may occur at these sites. The potential for vessel strikes is limited by the slow speed of tugboat and barge operations. Recent ship speed reductions imposed on all vessels 65 ft and greater in length have been found to be effective in reducing strikes to whales (Conn & Silber (2013); NOAA (2013)). No strikes to endangered or threatened species or to dolphins and seals are known to have occurred in the history of the DAMOS program. Potential adverse impacts would be limited and of short duration.

The primary impacts to the water quality following dredged material placement are associated with the residual particles that remain suspended from minutes to a few hours after the majority of sediment has reached the seafloor. These impacts may be adverse (light reduction, interference with biological processes) or beneficial (increased productivity of specific species as the suspended sediment may serve as a food source). The impacts of suspended solids on DO water column concentrations are expected to be minimal. Although DO levels may temporarily decline following placement in offshore areas, no major declines or persistent impacts have been observed for the placement of general sediment classes found in the northeast region (Fredette & French (2004); Johnson, et al. (2008)).

Other potential effects on the water column could include the release of nutrients from discharged sediments. Nutrients in sediments are generally bound to the sediment and organic particles and can occur in the pore water (water within the sediments) depending on the physical and chemical properties of the sediment. In general, offshore coastal waters are nitrogen-limited and not as biologically sensitive to placement-related nutrients compared to inshore lakes, which are phosphorus-limited (Johnson, et al., 2008). The nitrogen TMDL for Long Island Sound, a management tool to decrease nutrient loading and improve DO concentrations,does not even mention material dredging or placement as a potential nutrient source (NYSDEC and CTDEP, 2000), as these are apparently insignificant relative to other sources such as rivers, wastewater treatment facilities, and atmospheric deposition.

Similar to nutrients, water quality may be impacted by the release of contaminants from sediment during placement; these impacts are expected to be limited and short-term. Sediment testing of dredged material limits the degree of sediment contamination that is allowed at designated sites and is designed to limit the potential release of contaminants during discharge and placement. Contaminants may be sediment-bound or in pore water, and the sediment affinity and release into the water column is influenced by characteristics of the contaminant (several are hydrophobic), as well as environmental conditions (Jones-Lee & Lee (2005); Eggleton & Thomas (2004)).

Available studies (Arimoto & Feng (1983); Gentile et al (1984); Peddicord (1988); Lee & Jones-Lee, (2000); Fredette, et al. (1993)) conducted prior to the application of the current testing requirements (EPA and USACE, 1991) demonstrate that some dredged material may result in short-term, spatially limited increases in the bioavailability of contaminant compounds at or near dredged material mounds. These studies did not find adverse impacts to organisms from dredged material placement. In addition, extensive research by USACE from the 1970s on the release of dredged material from hopper dredging found that "…of the over 30 chemical parameters…measured, including heavy metals a variety of organics and other constituents, only ammonia and manganese were released from the sediments" as long as the sediment water slurry was oxic (contained dissolved oxygen) (Lee & Jones-Lee, 2000). These studies also found that if sediment slurry stayed anoxic, many contaminants were released. Due to the short exposure time and limited release from even contaminated sediments, it was concluded that placement from hoppers or mechanical dredging would not result in water quality problems (Lee & Jones-Lee, 2000). During plume studies of Providence River dredged material placed at the RISDS, water samples were collected and analyzed for toxicity within the first two hours; the analysis found that "Neither the mysid (*Americamysis bahia*) nor juvenile silverside (Menidia spp.) test organisms exhibited a lethal response" after four days of exposure (ENSR, 2008).

Although benthic recolonization and resuspension of deposited sediments may potentially contribute to bioaccumulation of contaminants, sediments associated with unacceptable risks are not accepted for open-water placement. Through the use of risk-based evaluations to select the appropriate management practices, it is expected that bioaccumulation of contaminants in tissues (and subsequent risks) would not increase significantly over ambient conditions as the result of placement of dredged material. Therefore, it is expected that potential risks associated with open-water placement alternative would either remain the same or possibly be reduced through the addition of material with lower chemical concentrations than those currently existing in surface sediments at sites that contain historic dredged material.

Under the unconfined open-water placement site alternative, transporting dredged materials for placement would involve tug and/or workboat operations. Dredged material placement would involve operation of dump scows during periods of placement activity and commuting vehicles from workers' travel to and from the dredging site, resulting in air pollutant emissions and potential adverse noise impacts. However, given the short duration of the activity and great distances between sensitive receptors and the alternative sites, potential air quality and noise impacts would not be significant relative to background levels.

The Field Verification Program (FVP) Mound: A key source of data for effects of dredged material placement in Long Island Sound

Dredged material placed in Long Island Sound must pass chemical and biological testing protocols, but an evaluation of potential effects of contaminants in Long Island Sound is available as a worst-case assessment. During 1982-1983, as part of the joint EPA/USACE FVP, the FVP mound was created in the CLDS. Just over 72,000 CY of organic-rich, fine-grained sediment with heavy metals, PAHs, and PCBs was placed at the site as part of a series of experiments. The dredged material was demonstrated to have both acute and chronic toxicity (Morton, et al. (1984); Gentile, et al. (1988)). The mound was not capped and has been used to evaluate a monitored natural recovery process of contaminated sediments over the past three decades (Myre & Germano, 2007).

Comparison of acoustic surveys conducted in 1983, 2011, and 2014 demonstrated that the mound has been stable with little physical change in over 30 years. Signs of active sediment transport have been limited; no changes in large-scale features have occurred and about 2 to 4 inches of new sediment from natural deposition was observed over the mound in 2005 and in 2011.

In 2005, contaminant concentrations at the center of the mound were higher than reference areas and tended to increase with depth, with the highest levels observed 6 to 8 inches below the surface (Myre & Germano, 2007). Even though some of the contaminants were above projected effects levels, the maximum contaminant concentrations at the FVP mound in 2005 were found to be less than the concentrations in the original dredged material; PAH concentrations declined from 142,000 μg/kg dw in the source dredged material to a maximum of 27,570 μg/kg dw at the FVP mound in 2005. The reduction in contaminants was attributed to active sedimentation combined with bioturbation, which in effect dilutes the sediment with cleaner sediments from the water column, as well as sediment microbia metabolism, which breaks down and transforms compounds (Myre & Germano, 2007).

Despite elevated contaminant levels, the benthos and seafloor conditions observed at the FVP mound in 2011 were consistent with those at the reference areas, showing advanced recovery at the mound and n indication of impairment (AECOM, unpublished). Similarly, in 2000, as part of the investigation for the EIS for site designation, a sample located on the flank had results that were relatively consistent with the flank in 2005 (Myre & Germano, 2007). Contaminant concentrations above the effects level were measured in 2000, however, toxicity testing and benthic community analyses indicated no significant differences in effects between the FVP mound and reference stations (EPA, 2004).

Infrastructure Impacts

Placement of dredged material in open water can potentially affect existing or future infrastructurewithin Long Island Sound. Submerged utility lines (electrical, telecommunications, gas pipeline) transit the Sound along approved corridors (Figures 4-68 thru 4-70) (EPA, 2004). Utility corridors are established to restrict disturbance of the seafloor above the buried lines and to allow utility access to repair or inspect lines. Any utility lines that exist within open-water alternatives could be buried by dredged material, which would make inspection and repair more difficult but is not likely to directly affect buried lines. Designation of open-water sites will restrict the establishment of new utility corridors in order to avoid disturbing placement sites.

The temporary transit of barges from harbor regions to and from the alternative sites and discharge at the site may displace shipping as well as recreational and commercial vessels in the transit area and at the alternative site, resulting in potential short-term impacts. Navigation lanes can be established across placement sites. In practice, all open-water placement sites need to be managed to ensure that adequate water depths are maintained to minimize impacts to navigation.

Cultural Impacts

Shipwrecks located in or adjacent to potential open-water placement site alternatives would be affected by burial from dredged material placement. Shipwrecks that have not been clearly located or identified could be obscured by burial but would also be protected from disturbance. The use of sites for dredged material placement is not likely to result in increased erosion or displacement of cultural artifacts, but site locations should be sited to avoid conflicts. Any cultural and archaeological resources that may have been present within existing placement sites have been previously disturbed or are currently protected from any further impacts resulting from prior placement activities (EPA, 2005).

Socioeconomic Impacts

Under the open-water placement alternatives, potential adverse impacts could occur from competing uses of the water system from nearby shipping lanes or aquaculture sites. During material placement, special precautions may need to be imposed during shipping activity near the alternative sites. Population concentrations near the open-water sites support heavy boat traffic and recreational use of the water system in which the sites are located. Material placement activities at the site could disrupt recreational use or pose boating hazards to the public unless proper precautions were taken. Placement activities could disturb the aesthetic quality of open-water views in the short term; however, long-term aesthetics are not expected to be impacted because the sites would be submerged under water.

Beneficial Impacts

Potential benefits from the implementation of open-water alternatives could accrue to infrastructure resources and to regional employment. An indisputable long-term beneficial consequence of any dredged material placement activity is that dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Placement of material for open-water alternatives may increase employment for tug/barge operators and operators of heavy machinery during periods of placement activity.

Placement of dredged material could reduce surface sediment contaminants and potential bioavailability by burying historic dredged material. Introducing fresh dredged material into an area may serve as a food source for the benthic community and benefit the marine food web. Increasing the diversity of the seafloor topography may also benefit demersal marine life.

Confined Open-Water Placement

Physical Impacts

Physical impacts from confined open-water placement would be similar to those associated with unconfined open-water placement, except for impacts to water depth and sediment transport. Because this alternative type involves placing material within an existing depression in the seafloor or a low area created by the circular placement of sediment mounds, the material is expected to be more stable and less subject to transport away from the site. In cases where a pit is being filled, there would be no impact to water depth or resulting impacts to boat traffic or navigation after placement operations were complete.

Environmental Impacts

Environmental impacts from confined open-water placement would be similar to those associated with unconfined open-water placement, described above.

Infrastructure Impacts

Infrastructure impacts from confined open-water placement would be similar to those for unconfined open-water placement.

Cultural Impacts

Cultural impacts from confined open-water placement would be similar to those for unconfined open-water placement.

Socioeconomic Impacts

Socioeconomic impacts from confined open-water placement would be similar to those for unconfined open-water placement. In addition, nearby oyster and clam beds may be disturbed or destroyed by material placement actions, with a subsequent loss of employment in the commercial or recreational fisheries dependent upon those sites.

Beneficial Impacts

Potential benefits from the use of confined open-water placement alternatives would be similar to those for unconfined open-water placement.

In cases where confined open-water placement occurs in an existing pit or depression on the seafloor, there exists the potential to increase or enhance habitat for benthic invertebrates and shellfish when the depth of the pit is restored to the ambient depth by filling the depression with dredged material. The potential for an increase in habitat diversity for fish species also exists because placement activities could create bathymetric variations.

5.1.2 In Harbor CAD Cell Impacts

CAD cells have become a preferred option for the management of dredged material that is contaminated and not suitable for open-water placement or beneficial use (Fredette, 2006). CAD cells are constructed to reduce the risk from exposure to contaminated sediments by storing them in a depression in the bottom of an aquatic system, then isolating them with a capping layer of sediment. They may be constructed from naturally occurring bottom depressions or from sites from previous mining operations (e.g., beach nourishment borrow sites); alternatively, they may be created expressly for containment by sediment excavation (Fredette, 2006). Other than some minor consolidation, CAD cells have been shown to be physically stable, with benthic recovery consistent with ambient areas in the Boston Harbor and four other New England harbors: Norwalk and New London, Connecticut; Providence, Rhode Island, and Hyannis, Massachusetts (ENSR (2007); USACE (2012a); USACE (2012b)). CAD cells have also been used in Newark, New Jersey; Los Angeles, California; Bremerton, Washington; and Hong Kong, China (Fredette, 2006). There are impacts associated with construction (where required), and there are impacts associated with the placement of dredged material within CAD cells for both constructed and natural depressions.

Physical Impacts

The CAD cell alters the existing sea floor and may change the existing sediment grain size and TOC through the potential removal of sediments during construction (which would have to be moved and placed elsewhere) as well as placement of the dredged material. For example, there would likely be impacts to sediments where native fine-grained sediments are replaced by more granular, sandy material used to cap the CAD cell. Anchoring of dredges during construction would temporarily physically disturb the seafloor and may have long-lasting impacts if compaction occurs, which would depend on the seafloor characteristics. There may be increased turbidity after dredged material discharge, but this has been previously found to dissipate rapidly (Lyons, et al., 2006), (ENSR, 2008)..

Because operations at the CAD cell would be below the sea floor elevation, modification of wave energy regimes would be limited compared to a structure rising above mean high water. Therefo re, there would generally be no impacts to littoral drift patterns/rates, currents, and waves as CAD cells were filled to ambient sea floor elevation.

Environmental Impacts

Excavation of the CAD cell and operation (dredging, filling, and capping) under the in-harbor CAD cell alternatives would destroy and/or bury any bottom-dwelling resources living within the footprint area. Resources in the adjacent areas (i.e., the surrounding environment) have the potential to be indirectly affected through sedimentation and increased water column turbidity. These impacts would be greatest for sedentary/immobile resources (e.g., wetlands, SAV, benthic infauna, shellfish). Species such as fish and lobster are mobile enough to avoid the descending material and could burrow out from beneath a modest thickness of deposited material. During construction of the CAD cells in the Providence River channel, sediments were found to dissipate quickly, with the bulk of plumes settling within the cell (ENSR, 2008). The benthic community would also experience short-term impacts from anchoring disturbance and possibly long-lasting localized habitat impacts if anchoring compacts sediment. It is anticipated that the reduction in diversity and abundance of benthic infauna and shellfish populations within the site would be short-term. Recovery to levels similar to pre-placement would likely occur within months to several years, as documented at other dredged material alternative sites in Long Island Sound (USACE, 2012b).

Federal and state-listed species, including marine mammals and reptiles, may experience harassment during construction and operation of the CAD cells. However, these organisms are not likely to be found in the nearshore area, particularly in harbor areas, and the same vessel traffic that would create noise and disturb these animals would also likely deter them from entering the area as well. Turbidity would increase during construction or dewatering; however, best management practices would limit the potential for this effect to impair water quality and habitat.

CAD cell operations have the potential to permanently change the habitat if the CAD cell were capped with sediment that differs from the native material. The eventual placement of a cap of suitable dredged material on the CAD cells would limit bioaccumulation of any contaminants in the dredged material and would allow a stable benthic community to develop. There is also a potential for habitat enhancement for fish and shellfish because bathymetric variations could potentially increase habitat diversity. For example, CAD cells created using an existing depression would create habitat by filling the depression to ambient depth.

Placement of dredged material could increase turbidity and contaminant concentrations within the residual plumes, potentially leading to intermittent, short-term changes in water quality. Under worst-case conditions, the potential for such water quality impacts would rise. During construction of the Boston CAD cells, all of the resuspension was relatively low, with the most significant resuspension occurring during the initial capping of uncapped sediments and decreasing resuspension in subsequent capping layers (Lyons, et al., 2006). CAD cells are generally constructed in environments where hydrodynamic characteristics are relatively static (i.e., limited wave action and wave-induced currents); under such conditions, dispersion of dredged material during placement or capping would likely be reduced when compared with more dynamic conditions. The thickness of the sediment cap (where a cap is deemed necessary), the equipment and dredging techniques selected, and the placement schedule with respect to tidal currents could be used to minimize water quality impacts at the in-harbor CAD cell alternative sites.

Construction and operation of in-harbor CAD cell sites would involve the use of tugs to haul CAD cell materials; tugs with dredges to dredge CAD cells during construction, and tugs and/or workboats to transport dredged materials, dump scows, and commuting vehicles for workers traveling to and from the dredging site during placement activities. These equipment and vehicle operations would generate air pollutant emissions and noise impacts in areas around these cells. However, given the short duration of the activity around the alternative sites, potential air quality and noise impacts are anticipated to be less than significant.

Infrastructure Impacts

Impacts to infrastructure resources (e.g., mooring areas, navigation channels, ports, coastal structures, cable/power/utility crossings, recreational areas, aquaculture, and dredged material alternative sites) present within the footprint of the CAD cell could include direct interference or burial. However, these impacts are not likely, since cell sites would ideally be located to avoid coastal areas where such infrastructure resources are present. Vessel traffic may be impinged at mooring areas, navigation channels, ports, and recreational areas at or near the alternative site during CAD cell construction and operation. This impact would be short-term and would cease once placement operations were completed. Particle settling during placement operations could potentially deposit sediment at resources adjacent to the CAD cell. Filling the CAD cell to ambient sea floor would have no undermining/erosion impacts to nearby infrastructure resources.

Cultural Impacts

Excavation and operation (dredging, filling, and capping) under the in-harbor CAD cell alternatives would destroy and/or bury any cultural resources (such as shipwrecks and archaeological resources) present within the footprint area. However, CAD cells would not be sited or constructed on a footprint that contained cultural resources, so these impacts would be avoided with proper project planning. Because the CAD cells would not protrude from the seafloor surface, there would be no visual impacts associated with this alternative type. While the CAD cell was being filled, increased sedimentation could impact cultural resources; however, this impact is expected to be of short duration and would be confined to the immediate vicinity of the CAD cell. Historic districts would not likely be impacted by CAD cells because changes in bathymetry would not result in wave focusing or increased erosion along the shoreline where these resources would be located.

Socioeconomic Impacts

Under the in-harbor CAD cell alternatives, adverse socioeconomic impacts could occur. Nearby major ferry routes and shipping lanes may be interrupted by construction of CAD cell sites. Recreational boating could be interrupted during construction activity. Aquaculture of shellfish could potentially be lost or disturbed, with subsequent loss of employment from commercial or recreational fisheries dependent upon those sites. Placement activities could disturb the aesthetic quality of harbor views in the short term; however, long-term aesthetics are not expected to be impacted because the cells would be submerged under water.

Beneficial Impacts

Over time, potential benefits from use of in-harbor CAD cells could accrue to man-made resources and to regional employment. A long-term beneficial consequence of any dredged material placement activity is that dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Also, potential positive employment impacts could accrue to the region from construction and use of in-harbor CAD cell sites for tug/barge operators and operators of heavy machinery.

In cases where CAD cells are constructed using existing pits or depressions on the seafloor, there exists the potential to increase or enhance habitat for benthic invertebrates and shellfish when the depth of the pit is restored to the ambient depth by filling the depression with dredged material. The potential for an increase in habitat diversity for fish species also exists because placement activities could create bathymetric variations.

5.1.3 CDF Impacts

Island and Shoreline CDF Impacts

Like CAD cells, CDFs are a means for managing contaminated sediments. A CDF is a diked enclosure having structures that retain dredged material solids. Because of their location in shallow water environments, impacts from dredged material placement in island CDFs and shoreline CDFs are generally anticipated to be similar, except for habitat conversion (see below). Differences between individual alternatives would be expected when different resources are present. In cases where resources unique to a specific alternative are present, more specific assessments of environmental consequences will need to be performed.

Physical Impacts

The CDF would alter the existing sea floor topography and shoreline. It may also change the existing sediment grain size and TOC, if the physical properties of the cap material were different from the native sediments. For example, there would likely be impacts to sediments where native fine-grained sediments are replaced by more granular, sandy material used to cap the CDF. Because CDFs change the shoreline and the nearshore sea floor elevation, wave energy regimes are altered; therefore, littoral drift patterns/rates, currents, waves, and sediment transport are impacted as the CDFs are filled to elevations above mean sea level. In some cases, island CDFs may decrease littoral drift landward of the CDF. Shoreline CDFs may even disrupt littoral drift rates by creating a barrier to sediment transport. However, both alternatives may also result in increased channelization by increasing currents and scouring through narrow channels between the island CDF and the shoreline or, in the case of shoreline CDFs, by deflecting currents. Lastly, nearshore wave energy may increase or decrease, depending on whether the CDF creates a steeper or shallower beach profile and whether the CDF provides shelter for other nearby shoreline areas.

Environmental Impacts

Dike construction and operation (dredging, filling, and capping) of the island and shoreline CDF alternatives would destroy and/or bury any bottom-dwelling resources living within the footprint area. Resources in the adjacent areas (i.e., the surrounding environment) have the potential to be indirectly affected through sedimentation and increased water column turbidity during CDF construction. These impacts would be greatest for sedentary/immobile resources (e.g., wetlands, SAV, and benthic infauna, including shellfish). Mobile species, such as fish and lobster, may be able to avoid dike construction,but any organisms within the diked footprint would be buried by the descending material being placed within the dike. Impacts to plankton during construction are anticipated to be temporary and short-term.

CDF construction and operations are expected to permanently change habitat within the project footprint, creating habitat for terrestrial and intertidal ecological communities Outside of the project footprint, impact to the diversity and abundances of subtidal benthic invertebrates is anticipated to be temporary and short-term. Recovery to levels similar to pre-placement would likely occur within months to several years, as documented at other dredged material placement sites in Long Island Sound. Recovery of vegetative resources in the project area would depend on changes in geomorphology and hydrology (wetland plants) or water depth and turbidity (SAV), as well as the specific design objectives, which may include habitat restoration.

Marine mammals and reptiles may experience harassment during construction and operation of the CDFs. However, their occurrence in nearshore areas, particularly in harbor areas, is unlikely. Furthermore, the noise created by operations and vessel traffic would likely deter these animals from entering the area. Turbidity and contaminant leaching would increase during construction or dewatering; however, best management practices would limit the potential for these effects to impair water quality and habitat. Construction of CDFs could also permanently alter or convert any EFH that is present. Impacts to Federal and state-listed terrestrial species are not expected because project footprints are currently inundated.

Under the island/shoreline CDF alternatives, there could be direct impacts to MPAs if the project footprint and an MPA overlap. However, the creation of island CDFs could also provide protection from wave energy, and shoreline CDFs could enlarge a coastal MPA. Both shoreline and island CDFs could also create bird feeding and nesting habitat, although construction and operation of a shoreline CDF could also result in short-term impacts to shorebird feeding and nesting areas from harassment and displacement.

When contaminated dredged material is placed in a CDF, contaminants could be mobilized in leachate that could be transported to the site boundaries by seepage. Subsurface drainage and seepage through dikes may reach adjacent surface water and groundwater and act as a source of contamination, if not properly managed. Intermittent, short-term changes in water quality could potentially occur within the residual plumes following placement of unsuitable dredged material, with a greater potential for water quality impacts under worst-case conditions. However, CDFs are usually effective at containing sediments within the dike during placement, and these impacts are unlikely. Wildlife could experience direct short-term exposure to unsuitable sediments within the CDF during placement before the CDF cap is in place; however, the noise and activity during operation would most likely deter wildlife from entering the CDF area. Operational controls can also be used to minimize releases and exposures.

Construction and operation of island and/or shoreline CDFs could involve the use of tugs to haul CDF materials; tugs with dredges to construct CDFs during construction; and tugs and/or workboats to transport dredged materials, dump scows, and commuting vehicles for workers traveling to and from the CDF sites. Dredged material may also be pumped directly to the CDF using pipelines or may be pumped directly from a hopper dredge to a CDF. These placement-related activities would generate air pollutant emissions around the CDF sites, and noise from these activities could potentially affect sensitive receptors along shorelines. Adverse impacts would likely be greater around the shoreline CDF sites because sensitive receptors are more likely to be found along shorelines; however, potential air quality and noise impacts would be short in duration and are anticipated to be less than significant.

Infrastructure Impacts

Impacts to infrastructure resources (e.g., mooring areas, navigation channels, ports, coastal structures, cable/power/utility crossings, recreational areas, aquaculture, and dredged material alternative sites) present within the footprint of the CDF could include direct and permanent interference or burial. Direct impacts to ports, however, are not anticipated, since shoreline CDFs would be sited to avoid coastal areas where ports are present. Vessel traffic could be impinged at mooring areas, navigation channels, ports, and recreational areas near, but not within, the alternative site during CDF construction and operation. This impact would be short-term and would cease once placement operations were completed.

Cultural Impacts

Construction and operation of island and shoreline CDFs would destroy and/or bury shipwrecks present within the footprint area. Impacts to archaeological sites are not anticipated because no archaeological sites were identified at any of the island or shoreline CDF alternative sites. There would be short-term visual impacts to historic districts during CDF construction and operation. Historic districts could also be impacted by CDFs because changes in bathymetry could result in wave focusing or increased erosion and channelization along the shoreline where these resources are located.

Socioeconomic Impacts

Under the island/shoreline CDF alternatives, adverse socioeconomic impacts could occur. Island and shoreline CDFs could disrupt or destroy shellfish aquaculture by creating land masses in open water, and commercial or recreational fisheries that harvest those sites could experience consequential loss of employment. Short- and long-term degradation of an open-water visual aesthetic is possible from land mass creation. Recreational boating may be interrupted during construction or precautions may be required to ensure public safety during construction of island or shoreline CDFs.

Beneficial Impacts

Over time, potential benefits could accrue to man-made resources, regional employment, and revenue from creation of CDFs. Dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Potential positive employment impacts may occur from construction and use of site for tug/barge operators and operators of heavy machinery. No change to tax revenue/property values is expected during the lifespan of island or shoreline CDFs. However, depending on their proximity to other land uses and demand for available vacant land, created land masses may produce opportunities for development at the end of the facility's useful life as a placement area.

The construction of shoreline and island CDFs may potentially create a physical benefit by modifying the littoral drift, currents, and waves at the CDF location, depending on engineering of the site. These changes may decrease shoreline wave energy and erosion, thus increasing SAV habitat, for example. Shoreline accretion due to wave sheltering could also enhance other shoreline habitats, including those found in MPAs. Bathymetric variations resulting from the creation of CDFs have the potential to increase habitat diversity for fish species, which has the potential to provide new or enhanced fisheries habitat and feeding areas for marine mammals. Depending on the specific project, there may be the option to incorporate habitat enhancement for upland and coastal wildlife and birds and for Federal and state-listed species into the final project design.

5.1.4 Landfill Placement Impacts

Landfills are facilities licensed and operated to accept waste. Some landfills are licensed to accept hazardous materials; others will accept only clean fill or construction and demolition material. In the past, unlined landfills were common, but these types of facilities have become increasingly rare due to increased water resource protection regulations.

Commercial fill material typically requires testing to characterize potential contaminants before placement is approved; during operation, freshly added waste material is generally covered daily (daily cover). Landfill areas that are inactive are covered to a greater extent (intermediate or temporary cover); after a landfill reaches its design capacity, a final cover is placed over the waste for long-term environmental protection after the material to be covered has stabilized. Final cover designs must address infiltration, drainage, vegetation, and erosion considerations.

Physical Impacts

Dredged material placed at a landfill site as waste would be placed along with other waste streams entering the facility. The dredged material would reduce the remaining landfill capacity and may require the placement of cover material to meet final design specifications. Landfills considered as alternative placement sites are active, disturbed locations so there would generally be no additional physical impacts associated with the dredged material placement beyond the current operation and management of the landfill.

Environmental Impacts

Landfill placement of dredged material is unlikely to have direct impacts to wetlands, birds, terrestrial wildlife, or threatened and endangered species since the alternative site would already be an established and operating landfill.

Dredged material placed at landfill sites as waste could potentially affect groundwater and surface water quality in the immediate area. In the case of coastal marine dredged material, additional salt and any leachable chemicals in the dredged material may require leachate management practices that prevent erosion or the deposition of material in adjacent resources.

Cover specifications may be necessary to minimize risk to environmental resources and would vary, depending on whether the design requires a daily, intermediate, or final cover. For example, daily cover is a minimal covering to deter wildlife scavenging and to control odor, wind-blown dust, and litter. An intermediate cover is generally a thicker, more permanent covering and may be designed to allow infiltration to enhance bioreactions. Final cover designs would address a more complete encapsulation of internal waste material while minimizing (precipitation) infiltration and cover erosion.

Secondary impacts associated with landfill placement would include the effects associated with material dewatering (dewatering fluid management, possible equipment emissions at the dewatering site) and transportation (emissions). Impacts from construction equipment emissions at the alternative sites are not considered because landfill operations will take place whether the waste material used is dredged material or is fill and debris from non-dredging sources.

This potential alternative would involve various activities associated with construction and placement elements. These activities would cause the following air quality effects:

- Criteria pollutant emissions, hazardous air pollutants (HAPs), and GHG emissions would result from construction and placement activities such as:
  - Use of diesel- and gas-powered equipment such as tug, dredge, dozer, loader, booster pump, work boat, dump scow engine, etc.
  - Material delivery and dump trucks.
  - Construction workers' commute vehicles.
- Fugitive dust would be generated by on-land construction and placement operations.

Impacts on local noise levels during placement activities would include noise from equipment operating at the project site and delivery vehicles traveling to and from the site. These impacts would also vary during placement, with the highest impacts likely occurring during any necessary earth movement phases due to the use of heavy construction equipment such as excavators, loaders, etc.

The noise impacts from operation of equipment and vehicles would be essentially temporary. Noise levels related to the equipment activities would vary with the type of equipment being used. Table 5-1 shows typical noise levels for various types of heavy construction equipment. It is anticipated that the principal equipment types that would be used include compressors, excavators, dredgers, and cranes. Because not every type of equipment would be used at a given time, noise levels would vary over the duration of placement activities.

Noise levels generated by construction equipment (or by any point source) decrease at a rate of approximately 6 dB per doubling of distance away from the source. For instance, at a distance of 200 ft from a noise source, the noise levels would be about 12 dB lower than the 50-ft reference distances shown in Table 5-1.

Dewatering of dredged material would potentially involve the operation of loaders, dozers, and workers' commuting vehicles at dewatering and landfill sites under this alternative. Trucks would be used to transport dredged materials for landfill placement. These equipment and vehicle operations would result in air pollutant emissions and noise impacts around the selected alternative site and along truck routes. Depending upon the scale and duration of landfill placement and/or landfill cover/capping activities at the selected sites and the sensitivity of the land around these sites, adverse air quality and noise impacts could be of concern.

On-road truck operations associated with material transport to and from landfill sites would also result in adverse air quality and noise impacts, particularly at sensitive land areas immediately adjacent to truck routes.

Infrastructure Impacts

Any dredged material placed at landfill locations could require the use of significant overland transportation resources, depending on the distance between the project site and the landfill location. This impact would be short-term and would cease once placement operations were completed.

Cultural Impacts

It is unlikely that historic districts or archaeological resources are located at landfill placement sites; therefore, no direct destruction of, or visual impacts to, cultural resources are anticipated under these alternatives.

Table 5-1. Typical Construction Equipment Noise Levels (dBA at 50 Ft).

Equipment Type	Typical Noise Levels[1]
Earthmoving:	
Loaders	85
Backhoes	80
Dozers	85
Scrapers	89
Graders	85
Truck	88
Pavers	89
Roller	74
Material Handling:	
Concrete Mixers	85
Concrete Pumps	82
Cranes	83
Derricks	88
Stationary:	
Pumps	76
Generators	81
Air Compressors	81
Impact:	
Pile Drivers (impact)	101
Pile Drivers (Sonic)	96
Jack Hammers	88
Pneumatic Tools	85
Other:	
Saws	76
Rock Drill	98
Tug[2]	85
Workboat[2]	84
Dredger[2]	85

Source: Federal Transit Administration (2006).
[1]dBA at ~50 ft.
[2]USACE and Los Angeles Harbor Department (2014).

Socioeconomic Impacts

Potential adverse effects from the transport of clean material to landfill sites would depend on the dewatering site location and the length of travel routes, routes taken, and volume of material transported. The increased number of trucks along the route could produce additional traffic congestion, noise, and air quality impacts to surrounding areas.

Beneficial Impacts

Over time, potential benefits could accrue to man-made resources, regional employment, and personal revenue from the placement of dredged material at landfill sites. A long-term beneficial consequence of any dredged material placement activity is that dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Employment of truck drivers and heavy equipment operators at origin and destination sites could increase but would be limited to the extent that material is available or quantity is needed for a site. Some sites require daily capping, which could increase employment among truck drivers and operators of heavy machinery handling the material; however, the increase would be temporary. Some sites could require only final capping, while other sites could receive material over the long term. Employment would correlate with the quantity and use of material placed at specific sites. Revenue from tipping fees would accrue to the owner/operator of the site.

Environmental benefits that could result from placing dredged material within an existing landfill include the isolation of potentially contaminated material and the placement of material within a location that is already disturbed and has existing infrastructure to effectively contain and isolate the material.

5.1.5 Beneficial Use Impacts

Nearshore Bar/Berm Placement Impacts

Nearshore berms are submerged, high-relief mounds, generally built parallel to the shoreline. They are commonly constructed of sediment removed from a nearby dredging project. There are typically two types: feeder berms and stable berms. Feeder berms are transient features that contain predominantly clean sand placed in the nearshore zone directly adjacent to a beach. Stable berms are generally longer-lasting features constructed in deeper water or low-energy environments, where sediment transport is limited. These berms could be constructed with finer-grained material since the environment is not conducive to wave or current-induced sediment transport.

Physical Impacts

The greatest physical impact associated with nearshore bar and berm placement would be the intentional change in bottom topography associated with placement. The change in bottom topography would in turn result in decreased wave energy, nearshore current patterns, and littoral sediment transport. In some cases, feeder berms would be created in areas where sustained landward transport of sediment would result in beach accretion. However, this could also reduce or increase littoral transport of sediment. There is also a potential for channelization of tidal flow because the bar or berm would divert tidal flow through the deeper areas between bars or berms. This channelization could potentially result in greater erosion through the deeper channels as the increased current energy causes more scouring. Depending on the distance from shore, bars and berms could also result in greater wave energy (as the shoaling would cause waves to break over the bars and berms) or decreased wave energy (since the energy would be dissipated over the bars and berms rather than at the shoreline).

Under the nearshore bar/berm placement alternatives, the placed material must first be determined to be compatible with the nearshore and beach sediments at the placement location. However, it would still be possible to have changes in sediment grain size distribution and TOC. Grain size distribution would also be influenced by any changes in tidal current and wave energy, which would affect sediment transport.

Environmental Impacts

Dredged material resuspension would result in short-term impacts to water quality, and material placement would increase turbidity. Turbidity could also increase as a result of increased sediment transport caused by channelized currents or focused wave energy. Phytoplankton could be impacted by the decreased light penetration that would result from the increase in turbidity, and both phytoplankton and zooplankton could sustain short-term impacts from entrainment during placement.

Direct destruction of SAV, wetlands, and benthic invertebrate populations, including shellfish populations, would occur through burial when material is deposited directly on these resources. In addition, there is the potential for direct destruction of fish that are Federally managed and for habitat impairment from the physical change in sediment characteristics or water depth. For SAV and wetlands outside of the bar or berm footprint and for nearby MPAs, there is the potential for increased sedimentation from changes in sediment transport processes or increased erosion from increased tidal or wave energy, both of which can also temporarily impact water quality because of increased turbidity.

During placement of dredged material, marine mammals and reptiles could potentially be subjected to strikes or harassment. Other threatened and endangered species could also be destroyed or buried if the species were immobile and were located within the bar or berm footprint. Habitat impairment could also occur under certain conditions: if resource habitat were located within the bar/berm footprint; if the migration of bar/berm material changed shoreline substrate, or if the bar/berm caused sedimentation or erosion.

Nearshore bar/berm placement could be accomplished in close proximity to a dredging site. Dredged materials could be transported by pumping or by barge/tug and could be placed using equipment at the site. Air quality and noise impacts could be of potential concern, depending on factors such as:

- The volume of material to be placed
- The distance to the alternative site
- The duration of placement activity
- The sensitivity of land uses immediately adjacent to the selected sites and/or transporting routes

Air quality and noise impacts would likely be of short duration and would be less than significant.

Infrastructure Impacts

Nearshore berm sites close to navigation channels could have an adverse impact on navigation due to shoaling. Utilities could also be buried during placement. Another potential impact would be changes in current patterns and wave energy that could result in erosion or deposition around docks, recreational areas, dredged material facilities, aquaculture facilities, and other coastal structures.

Cultural Impacts

During dredged material placement, cultural resources could potentially be destroyed, buried, or disturbed. Changes in local sedimentation or erosion due to changes in littoral drift, shoreline erosion due to wave-focusing, or runoff during dewatering could also result in burial or disturbance. These changes could impact local aquaculture operations, recreational activities, and waterborne commerce. In addition, during placement activities, there would be a temporary adverse impact to aesthetic quality.

Socioeconomic Impacts

Under the nearshore bar/berm alternatives, shellfish aquaculture could potentially be disrupted or destroyed, resulting in a consequential loss of employment dependent on those aquatic resources. Waterborne commerce and recreational boating activity could also be disrupted. Submerged pipelines could be within the construction area of the sites and could be at risk if they were disturbed by construction activities. Some short-term aesthetic value losses would be possible during construction of the nearshore bars/berms. Nourishment of public beaches could result in more visitations and increased traffic in the immediate area.

Beneficial Impacts

Under the nearshore bar/berm alternatives, potential benefits could accrue over time to man-made resources, visual aesthetics, public services and facilities, regional employment, and public revenue. Dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Allowing littoral drift to nourish beaches would likely result in a more developed beach profile, thereby reducing damage to properties bordering the beach during coastal storm events. Nourishment and reestablishment of beach areas could result in long-term visual aesthetic benefits, as well as contribute to greater recreational utility and public enjoyment of sites. Other ecosystem services could accrue to the population at large. Employment could increase for barge and tug operators and heavy machinery operators involved in the placement of material. If nourishment of beachfronts produced additional usable beach area and encouraged recreational usage, public revenues could increase from associated visitation fees.

A number of physical benefits would result from the construction of both feeder berms and stable berms. If feeder berms were constructed, new sediment would be introduced to the littoral system, beaches would be nourished through onshore sediment transport, and nearshore wave energy, and therefore shoreline erosion, would be reduced. If stable berms were constructed, wave energy along the shoreline would be reduced, resulting in lower shoreline erosion.

These physical benefits could lead to environmental benefits, such as increasing SAV habitat through wave sheltering. Shoreline accretion due to reduced wave energy and erosion could also enhance other shoreline habitats, including those found in MPAs. Bathymetric variations resulting from the creation of nearshore berms have the potential to increase habitat diversity for fish species, which has the potential to provide new or enhanced fisheries habitat and feeding areas for marine mammals. Depending on the specific project, there could be the option to incorporate habitat enhancement for upland and coastal wildlife and birds into the final project design.

Nearshore berms also could result in beneficial impacts to nearby cultural resources and infrastructure through reduced wave energy and shoreline accretion, thereby reducing the risk of storm damage and erosion to these resources.

Beach Nourishment Impacts

The term "beach nourishment" generally refers to the process of adding sediment, also known as "beach fill," to a beach and/or dune system. In general, there are two types of beach nourishment projects:

- the beneficial use of clean, compatible sediment from a nearby dredging project to augment the volume of a beach or dune by directly placing sand either on the beach/dune or in the nearshore, where it can act as a source of sediment for the beach/dune system, and
- a designed, engineered project where a specified volume of sand is added to a beach/dune system to provide a desired level of storm damage protection and flood control.

Physical Impacts

The greatest impact associated with beach nourishment is the change in beach profile. Although the profile change is intentional, it can either dissipate or focus wave energy, change littoral currents and sediment transport, and result in shoaling.

The most important factor for beach nourishment projects is the grain size distribution of the source material as compared to the native beach material, also referred to as sediment compatibility. For dredging projects, state policy requires that clean, compatible sediment be placed on adjacent beaches to keep the material in the littoral system. Although the placed material must first be determined to be compatible with the nearshore and beach sediments at the placement location, it would still be possible to have changes in sediment grain size distribution and TOC. Grain size distribution would also be influenced by any changes in littoral current and wave energy, which would also affect sediment transport. Note that location is important If sediment were placed where it would not be stable due to its incompatibility, then unintended adverse impacts on eelgrass, shellfish beds, salt marshes, or the dredge channel could result.

Environmental Impacts

Dredged material resuspension would result in short-term impacts to water quality, and material placement would increase turbidity. Turbidity could also increase as a result of increased sediment transport caused by channelized currents or focused wave energy. Phytoplankton could be impacted by the decreased light penetration that would result from the increase in turbidity, and both phytoplankton and zooplankton could sustain short-term impacts from entrainment during placement.

Direct destruction of SAV, wetlands, and benthic invertebrate populations, including shellfish populations, would occur through burial when material is placed directly on these resources. In addition, there is the potential for short-term impacts to fish that are Federally managed (from the temporary decrease in water quality) and for habitat impairment (from the physical change in sediment characteristics or water depth). For SAV and wetlands located outside of the placement footprint and for nearby MPAs, sedimentation could increase or decrease as a result of changes in the littoral transport of sediment.

Under the beach nourishment alternatives, marine mammals and reptiles could be subjected to strikes or harassment during placement of dredged material. Other threatened and endangered species could also be destroyed or buried if the species are immobile and are located within the placement footprint, and shorebird nesting habitat could experience adverse impacts. During dredged material placement, wildlife that use the beach could be temporarily displaced.

Beach nourishment could be accomplished in close proximity to a dredging site. Dredged materials could be transported by pumping or by tug or truck for placement if needed, and materials could be placed using equipment at the site. Air quality and noise impacts could be of potential concern, depending on typical factors such as:

- The volume of material to be placed
- The distance to the alternative site
- The duration of placement activity
- The sensitivity of land uses immediately adjacent to the selected sites and/or transporting routes

Air quality and noise impacts would likely be of short duration and would be less than significant.

Infrastructure Impacts

Impacts to infrastructure from beach nourishment include potential impacts to utilities, mooring areas, aquaculture beds, and coastal structures from burial or increased sedimentation. Upland dewatering of material could require truck hauling and the use of public roadways for transit, resulting in potential increased traffic congestion. Nourishment could encourage more visitations and increased traffic in the immediate area.

Cultural Impacts

Where archaeological sites are present nearby, there is the potential for increased sedimentation or erosion from changes in current and wave energy and changes in sediment transport Aesthetic quality would be temporarily reduced and recreational activities would be temporarily disrupted Impacts to aquaculture could occur as a result of burial or increased sedimentation over shellfish beds. Waterborne commerce and recreation could also be temporarily disrupted. Improvements to recreational beaches would ultimately draw more revenue from visitors.

Socioeconomic Impacts

Under the beach nourishment alternatives, shellfish aquaculture could potentially be disrupted or destroyed, resulting in a consequential loss of employment dependent on those aquatic resources. Waterborne commerce and recreational boating activity could also be disrupted. Submerged pipelines could be within the construction area of the sites and could be at risk if they were disturbed by construction activities. Some short-term, adverse aesthetic impacts would be possible during nourishment activities. Upland truck hauling would require dewatering of material and use of public roadways for transit, resulting in potential increased traffic congestion and air quality impacts. Nourishment of beaches could encourage increased visitations and traffic in the immediate vicinity of the sites.

Beneficial Impacts

Under the beach nourishment alternatives, potential benefits could accrue over time to man-made resources, visual aesthetics, public services and facilities, regional employment, and public revenue. Dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Nourishment of beaches would result in a more developed beach profile, thereby reducing damage to properties bordering the beach during coastal storm events. Nourishment and reestablishment of beaches could result in long-term visual aesthetic benefits and could contribute to greater recreational utility and public enjoyment of sites. Other ecosystem services could accrue to the population at large from beach nourishment Employment could increase for barge and tug operators or truck drivers and heavy machinery operators involved in the placement of material. If reestablishment of beachfront produced additional usable beach area and encouraged recreational usage, public revenues could increase from associated visitation fees.

Beneficial use projects are designed to keep dredged sediment in the littoral system but not necessarily to provide any specific level of protection, while engineered projects are designed to provide a specific level of storm damage protection. Shoreline accretion due to beach nourishment has the potential to enhance a variety of shoreline habitats, including those found in MPAs. Depending on the specific project, there could be the option to directly incorporate habitat enhancement for upland and coastal wildlife and birds into the final project design. Beach nourishment also could result in positive impacts to nearby cultural resources and infrastructure through reduced wave energy and shoreline accretion, thereby reducing the risk of storm damage and erosion to these resources.

Landfill Cover/Capping Impacts

Landfills require capping material to sequester waste material from the environment. In most cases, dredged material would be used in some form of cover application (daily, intermediate, or final cover).

Physical Impacts

Dredged material placed at a landfill site as daily or intermediate cover would be placed along with other waste streams entering the facility. Final cover material could be placed during the closure process of the site or at portions of the site. Landfills considered as alternative placement sites are active, disturbed locations, so there would generally be no additional physical impacts associated with dredged material placement beyond the current operation and management of the landfill.

Environmental Impacts

The use of dredged material as a landfill cap or cover would likely not result in direct impacts to wetlands, birds, terrestrial wildlife, or threatened and endangered species since the alternative sites are already established and operating landfills.

Dredged material placed as cover could potentially impact groundwater and surface water quality in the immediate area. Dredged material used in this manner would need to be characterized to determine whether it meets specific design criteria to limit impacts on adjacent resources from increased salt content, leachable contaminants, or increased sediment load in stormwater runoff.

Secondary impacts associated with landfill cover applications would include the effects associated with material dewatering (dewatering fluid management, possible equipment emissions at the dewatering site) and transportation (emissions). Impacts from construction equipment emissions at the alternative sites are not considered because landfill cover operations will take place whether the capping material used is dredged material or is excavated from non-dredging sources.

Under the landfill capping/cover alternatives, dewatering of dredged material would potentially involve operation of loaders, dozers, and workers' commuting vehicles at dewatering and landfill sites. Trucks would be used to transport dredged materials for landfill placement. These equipment and vehicle operations would result in air pollutant emissions and noise impacts around the selected placement site and along truck routes. Depending upon the scale and duration of landfill cover/capping activities at the selected sites and the sensitivity of the land around these sites, adverse air quality and noise impacts could be of concern.

On-road truck operations associated with material transport to and from landfill sites would also result in adverse air quality and noise impacts, particularly at sensitive land areas immediately adjacent to truck routes.

Infrastructure Impacts

Any dredged material used as cover material at landfills could require the use of significant overland transportation resources, depending on the distance between the project site and the landfill location. This impact would be short-term and would cease once placement operations were completed.

Cultural Impacts

It is unlikely that historic districts or archaeological resources are located at landfill placement sites; therefore, no direct destruction of, or visual impacts to, cultural resources are anticipated under these alternatives.

Socioeconomic Impacts

Potential adverse effects from the transport of clean material to landfill sites would depend on the dewatering site location and the length of travel routes, routes taken, and volume of material transported. The increased number of trucks along the route could produce additional traffic congestion, noise, and air quality impacts to surrounding areas.

Beneficial Impacts

Over time, potential benefits could accrue to man-made resources, regional employment, and personal revenue from the placement of dredged material at landfill sites. A long-term beneficial consequence of any dredged material placement activity is that dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Employment of truck drivers and heavy equipment operators at origin and destination sites could increase but would be limited to the extent that material is available or quantity is needed for a site. Some sites require daily capping, which could increase employment among truck drivers and operators of heavy machinery handling the material; however, the increase would be temporary. Some sites could require only final capping, while other sites could receive material over the long term. Employment would correlate with the quantity and use of material placed at specific sites. Revenue from tipping fees would accrue to the owner/operator of the site.

Depending on the specific project, there could be the option to directly incorporate habitat enhancement for upland and coastal wildlife and birds into the final project design.

Brownfields and Other Redevelopment

Dredged material could be used beneficially to redevelop Brownfield sites within the study area. For example, the site of a former airport in Flushing, New York (Site 422/423) was identified as a potential redevelopment site at the time of this PEIS publication. The site has both wetland and upland components and could receive clean fill for capping purposes following the remediation of any contaminated sediments or soils.

Physical Impacts

Brownfield sites are already highly disturbed, remediated sites. Placement of dredged material at these sites as clean fill or capping material is not likely to generate additional physical impacts beyond the remediation operations at the site. However, there would be potential impacts from an increased sediment load in stormwater runoff and changes in grain size and TOC, depending on source material and the project design.

Environmental Impacts

The use of dredged material as fill or cap material at Brownfield sites is unlikely to harass mobile resources such as birds or terrestrial wildlife, but these resources could be temporarily displaced during placement activities.

Where wetlands or critical habitats are located within or near a Brownfield redevelopment site, these resources could potentially be buried or destroyed. However, a Brownfield redevelopment project presents the opportunity to improve previously degraded environmental resources by removing invasive species, reconstructing wetland hydrology, reintroducing native vegetation, and improving sediment and soil quality.

Dredged material placed as fill or cover has the potential to impact groundwater and surface water quality in the immediate area. Dredged material used in this manner would need to be characterized to determine whether it meets specific design criteria to limit impacts on adjacent resources from increased salt content, leachable contaminants, or increased sediment load in stormwater runoff.

Secondary impacts associated with Brownfield redevelopment applications would include the effects associated with material dewatering (dewatering fluid management, possible equipment emissions at the dewatering site) and transportation (emissions). Impacts from construction equipment emissions at the alternative sites are not considered because Brownfield remediation and restoration activities will take place whether the fill and capping material used is dredged material or is excavated from non-dredging sources.

Dewatering of dredged material would potentially involve the operation of loaders, dozers, and workers' commuting vehicles at dewatering and Brownfield sites under this alternative. Trucks would be used to transport dredged materials for upland placement. These equipment and vehicle operations would result in air pollutant emissions and noise impacts around the selected placement site and along truck routes. Depending upon the scale and duration of placement activities at the selected sites, the distance to the placement site, and the sensitivity of the land around these sites, adverse air quality and noise impacts could be of concern.

On-road truck operations associated with material transport to and from Brownfield sites would also result in adverse air quality and noise impacts, particularly at sensitive land areas immediately adjacent to truck routes.

Infrastructure Impacts

Dredged material placed at Brownfield sites would likely require the use of overland transportation and construction resources, depending on the distance between the project site and the alternative location. This impact would be short-term and would cease once placement operations were completed.

Cultural Impacts

It is unlikely that historic districts are located within Brownfield sites; therefore, no adverse impacts from direct destruction of cultural resources are anticipated under these alternatives. Where archaeological resources are present, these resources could be destroyed if they are within areas excavated for remediation or removal of subsurface contaminants. No adverse visual impacts to cultural resources are anticipated since the site aesthetics would be improved as part of the redevelopment project.

Socioeconomic Impacts

Under the Brownfields/redevelopment alternatives, adverse socioeconomic impacts could occur. Some short-term, adverse aesthetic impacts would be possible during construction. Potential adverse effects from the transport of clean material to redevelopment sites could occur; the impacts would depend on the dewatering site location and length of travel routes, the route taken, and the volume of material transported. An increase in the number of haul trucks along the route taken could produce additional traffic congestion, noise, and air quality impacts within the surrounding area.

Beneficial Impacts

Over time, the use of Brownfields or other redevelopment sites for material placement could result in benefits to man-made resources, aesthetics, public facilities, and regional employment. Dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Conversion of a degraded site to a publicly accessible natural park area would benefit the public at large by providing increased recreational opportunities and decreasing the risk of exposure to site contamination. The visual aesthetics of the site would be improved over the long term. Employment could increase with the need for truck drivers and heavy machinery operators at origin and destination sites to handle placement material.

Depending on the specific project, there could be the option to directly incorporate habitat enhancement for wetlands and for upland and coastal wildlife and bird species into the final project design.

Mines and Quarries

Dredged material could be used beneficially to reclaim open mines and quarries. Within the region, typical mining operations include sand, gravel, limestone, granite, iron ore, and copper ore. Unlike a managed landfill, these sites are not likely to be lined disposal areas; therefore, additional characterization of the source material could be required to ensure that fill material meets applicable regulations and design specifications.

Physical Impacts

Mines or quarries considered as alternative placement sites are disturbed locations, so additional physical impacts associated with the placement of dredged material would not be expected. However, there could be potential impacts from an increased sediment load in stormwater runoff and changes in grain size and TOC content depending on the source material and the project design.

Environmental Impacts

The use of dredged material as a fill for open mines and quarries is unlikely to have direct impacts to wetlands, birds, terrestrial wildlife, or threatened and endangered species because the alternative sites are already established excavation and mining areas.

Dredged material placed in mines or quarries could potentially impact groundwater and surface water quality in the immediate area. Dredged material used for this purpose would need to be characterized to determine whether it meets specific design criteria to limit impacts on adjacent resources from increased salt content, leachable contaminants, or increased sediment load in stormwater runoff.

Secondary impacts associated with the placement of dredged material in a mine or quarry would include the effects associated with material dewatering (dewatering fluid management, possible equipment emissions at the dewatering site) and transportation (emissions). Impacts from construction equipment emissions at the alternative sites are not considered because reclamation activities will take place whether the fill material used is dredged material or is excavated from non-dredging sources.

Dewatering of dredged material would potentially involve the operation of loaders, dozers, and workers' commuting vehicles at dewatering and mine/quarry sites under this alternative. Trucks or rail lines would be used to transport dredged materials for upland placement. These equipment and vehicle operations would result in air pollutant emissions and noise impacts around the selected placement site and along truck/rail routes. Depending on the scale and duration of placement activities at the selected sites, the distance to the placement site, and the sensitivity of the land around these sites, adverse air quality and noise impacts could be of concern.

On-road truck or rail operations associated with material transport to and from mine/quarry sites would also result in adverse air quality and noise impacts, particularly at sensitive land areas immediately adjacent to truck/rail routes.

Infrastructure Impacts

Any dredged material placed at quarry or mine locations could require the use of significant overland transportation resources, depending on the distance between the project site and the alternative location. This impact would be short-term and would cease once placement operations were completed.

Cultural Impacts

It is unlikely that historic districts or archaeological resources are located at mine or quarry sites; therefore, no impacts from direct destruction of, or visual impacts to, cultural resources are anticipated under these alternatives.

Socioeconomic Impacts

A basic assumption under the mine and quarry alternatives is that dredged material would be transported by rail for the long haul as opposed to trucking the material. This assumption influences the projection of socioeconomic and other impacts.

Rail service adjacent to quarry and mine sites is assumed based on the original use of these sites. Adverse impacts could accrue from an increased number of trucks used to move material from dewatering sites to railways, which may result in traffic congestion and adverse air quality and noise impacts. Rail access from potential dewatering sites, particularly on Long Island, could prove problematic since freight rail service is limited east of the Hudson River in New York City and on Long Island. However, at the quarry and mine sites, truck hauling would likely be confined within the site or nearby, so public roadway use would not be required.

Beneficial Impacts

Over time, potential benefits could accrue to man-made resources, regional employment, and personal revenue. Dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Transport of material is expected to be by rail for long hauls, with no change to employment from rail mode. For short hauls, additional truck drivers and heavy machinery operators could be employed to handle the material at the origin and destination. Revenues from tipping fees are expected to accrue to the owner/operator of the site.

Depending on the specific project, there could be the option to directly incorporate habitat enhancement for wetlands and for upland wildlife and bird species into the final project design.

Habitat Restoration/Enhancement or Creation

Certain alternative placement sites present opportunities to beneficially use dredged material to enhance or restore degraded habitat. These sites could involve shoreline or island restoration, wetland restoration activities, or upland habitat projects.

Physical Impacts

Using dredged material for habitat restoration projects could have impacts on physical resources by altering stormwater drainage patterns as well as currents, littoral drift, and wave action for coastal sites. These impacts could be either mitigated or engineered to result in beneficial impacts, depending on the project design.

Environmental Impacts

There would be potential environmental impacts from the use of dredged material at habitat restoration sites. Benthic habitat and wetlands could be buried or destroyed, plankton could be entrained, and turbidity could increase during placement and construction operations. Birds, marine mammals and reptiles, and terrestrial wildlife could potentially be harassed during construction, but this would be unlikely because most of these resources are mobile.

Dredged material could adversely impact groundwater and surface water quality in the immediate area of the restoration site. Dredged material used in this manner would need to be characterized to determine whether it meets specific design criteria to limit impacts on adjacent resources from increased salt content, leachable contaminants, or increased sediment load in stormwater runoff.

Adverse impacts to water quality and aquatic habitats would likely be of short duration, with invertebrate communities recovering to pre-disturbance levels within months or years of placement. Short-term impacts to currently degraded coastal, wetland, and upland resources at these sites could be mitigated or improved following project completion. The final design could include ecosystem enhancements such as removing invasive species, reintroducing native species, and increasing the quality and extent of historically abundant habitats such as maritime forests, coastal grasslands, dunes, and salt marshes.

Secondary impacts associated with the use of dredged material at habitat restoration sites would include the effects associated with material dewatering (dewatering fluid management, possible equipment emissions at the dewatering site) and transportation(emissions). Impacts from construction equipment emissions at the alternative sites are not considered because restoration activities will take place whether the fill material used is dredged material or is excavated from non-dredging sources.

Dewatering of dredged material would potentially involve the operation of loaders, dozers, and workers' commuting vehicles at dewatering and habitat restoration sites under this alternative. Trucks would be used to transport dredged materials for upland placement. These equipment and vehicle operations would result in air pollutant emissions and noise impacts around the selected placement site and along truck routes. Depending on the scale and duration of placement activities at the selected sites, the distance to the placement site, and the sensitivity of the land around these sites, adverse air quality and noise impacts could be of concern.

On-road truck operations associated with material transport to and from habitat restoration sites would also result in adverse air quality and noise impacts, particularly at sensitive land areas immediately adjacent to truck routes.

Infrastructure Impacts

Dredged material used for habitat restoration could require the use of overland or overwater transportation resources, depending on the project site and alternative location. This impact would be short-term and would cease once placement operations were completed.

Cultural Impacts

It is unlikely that historic districts are located within habitat restoration sites; therefore, no impacts from direct destruction of cultural resources are anticipated under these alternatives. Where archaeological resources are present within or near the site, there is the potential for changes in sedimentation/erosion, which could adversely impact these resources by burying them or exposing them through erosion of the covering material. Visual impacts to cultural resources would be unlikely at habitat restoration sites because the material to be used for restoration would likely be similar to existing beach material.

Socioeconomic Impacts

Under the habitat restoration alternatives, adverse socioeconomic impacts could occur. The impacts of transporting clean material to alternative sites would depend on the origin of the dewatering site and the length of travel routes, the route taken, and the volume of material transported. The number of trucks required to move material could result in additional traffic congestion. Aesthetic quality could be reduced during construction. Reestablishment of recreational beachfront could encourage more visitations and consequently increased traffic in the immediate area, based on the site's recreational appeal.

Beneficial Impacts

Over time, potential benefits could accrue to man-made resources, aesthetics, public facilities and services, regional employment, and revenue. Dredging (and therefore dredged material placement) allows for the continued operation of the ports and harbors within Long Island Sound. Beach-compatible sand placement would remediate erosion along the beachfront, protect nearby infrastructure, and enhance the beach and dune habitat for greater recreational and other ecosystem service opportunities for the population at large. Nourishment of a wetland site would restore wetlands and improve habitat quality for greater recreational opportunities and other ecosystem services to the population at large. A long-term effect could be an improved visual aesthetic. Employment could increase with the need for barge operators, truck drivers, and heavy machinery operators to handle material at origin and destination sites. Enhancement of upland sites could increase revenue by encouraging visitation to public parks and nearby wetlands.

Depending on the specific project, dredged material placement could be used to alter the physical characteristics of a site to provide physical benefits such as reduced wave energy and erosion and increased shoreline accretion. The goal of these types of projects would be to restore degraded habitats so that they could once again support healthy, functioning natural ecosystems. The restored habitats and the ecosystems they support could include Federal and state-listed species, benthos, fish, shellfish, terrestrial wildlife, and birds, depending on the location of the site and the final project design.

5.1.6 Innovative Treatment Technologies

Innovative treatment technologies (see Chapter 3) could be used to neutralize or remove contaminants from sediment and create products with beneficial use applications, such as manufactured soil for Brownfield remediation, public landscaping, highway projects, landfill daily cover and closure, and a growing medium. The impacts associated with both the treatment processes themselves and the use and application of the resulting products in the environment are described below.

Physical Impacts

Innovative treatment technologies would likely be located in upland sites in former or existing industrial areas and would not result in physical impacts to the environment. Innovative treatment products could be used in a variety of settings, depending on the end products of the technology used. Any physical impacts to the environment would need to be assessed on a site-specific basis and would depend on the use of the end product.

Environmental Impacts

Impacts to aquatic resources from the use of chemical or thermal innovative treatment technologies would be limited to spills during handling, runoff from storage piles, and discharges of effluent. Technologies that involve placing dredged material on soil for natural or enhanced natural treatment (composting, land farming, land tilling, and bioremediation) could potentially impact surface water or wetlands. Runoff could entrain dredged material (raw or finished product), and contaminants or chemicals such as fertilizers or surfactants used as additives for treatment could leach or dissolve from the material. These impacts, however, are technology-specific, and a mass balance of the process systems would usually be able to foresee what impacts could result and how they could be potentially mitigated. Spills during handling and discharged effluent from dewatering are additional sources of potential impacts. However, dredged material suitable for these technologies either would have relatively low contaminant levels or would contain contaminants that are easily biodegradable.

Permit requirements would stipulate on-site treatment systems, and runoff controls combined with best management practices would minimize the potential for discharges from runoff and control potential spills. The effects of spills, if they did occur, would be localized. Dredged material handling coupled with best management practices in the industry have significantly progressed over the last several years to be able to minimize and quickly mitigate any spills.

Discharges from effluent and runoff that reach surface water bodies could have far-reaching impacts because surface water or tidal currents could widely distribute contaminants. Permitting requirements would specify appropriate controls and treatment for the overall operation of such facilities so that effluent met water quality standards. It is assumed that effluent would be monitored for compliance with the permit requirements.

Contaminants could also leach into groundwater as a result of gravity draining excess moisture from stockpiles; the exposure of stockpiles to rainfall; dredged material spread over land for composting, land farming, land tilling, and bioremediation; and spills. The potential effects would be site-specific and would depend on many factors that would need to be evaluated prior to implementation. Potential impacts to groundwater could be minimized by using impermeable liners, enclosures, runoff collection systems, and leachate collection systems as determined by permitting requirements. It should be noted that usually the dredged material is not placed in an "as is" dredged state owing to the fluidity of the material. Raw dredged material is difficult to move on upland areas without some form of dewatering prior to upland placement.

Technologies such as composting, land farming, land tilling, and bioremediation involve spreading dewatered dredged material over large areas. Vegetation could need to be cleared from some sites. Spread dredged material would be exposed to foraging species such as birds and small mammals; these species may attract predators, including protected species such as peregrine falcons. Though contaminant loads for such technologies would be relatively low or the contaminants would be biodegradable, contaminants could potentially enter the food web. Site-specific studies would need to be conducted and specific contaminants present in the raw material would need to be evaluated prior to the use of these technologies. Stockpiles and processing areas for material containing volatile contaminants could need to be enclosed.

An innovative treatment technology facility using chemical or thermal technologies would likely be sited in an existing industrial area, thereby limiting the potential for exposure of terrestrial wildlife. Stockpiled unprocessed dredged material could contain organic matter or eventually become vegetated over time, which could attract foraging species and their predators. Because the dredged material could potentially contain relatively high levels of contaminants and contaminants that volatilize, there is a potential for contaminants to enter the food web. Though large volumes of dredged material in stockpiles are typically stored uncovered, storage under a protective covering or roofed structure could reduce or eliminate that potential.

Processing sites for innovative treatment technologies would likely be located in upland industrial areas or highly disturbed sites. These areas generally are not habitat for threatened or endangered species. Consequently, the use of innovative treatment technologies would not impact threatened or endangered species or EFH. However, predatory birds such as peregrine falcon, which are sometimes found in urban areas, could inhabit the area and could potentially be impacted by these technologies.

Air quality impacts would vary depending on the technology. These impacts would need to be evaluated specifically for the contaminants present in the material to be processed, the site location and its proximity to sensitive receptors, and the treatment process train. Innovative treatment processes include specialized air handling equipment and monitors to comply with applicable air quality requirements.

Sediment could contain contaminants that are volatile. Volatilization of contaminants in the dredged material could occur in stockpile areas, during handling, and during treatment. An example is the addition of Portland cement for dewatering or stabilization, which causes an exothermic reaction with the dredged material that can potentially release volatile metals and organics. Enclosures or other controls to contain and treat volatilized contaminants could be needed. Dust from stockpiles and handling, particularly from composting, land farming, and land tilling, could affect air quality or potentially disperse contaminants. Dust control measures also could be needed.

Emissions from equipment, fuel burning, or temperature-based treatment processes would be subject to air quality standards. Permitting for such facilities would require air pollution control systems and strict compliance monitoring.

Innovative treatment technologies use machinery, industrial processes, yard equipment, and trucks. Siting such facilities in industrial areas and using controls, such as noise-damping components on machinery and generators, could minimize or eliminate potential noise impacts to surrounding areas and sensitive receptors.

Infrastructure Impacts

Traffic generated from the use of innovative treatment technologies would vary greatly depending on the technology, the location of the processing facility, and the end use of the processed dredged material. In general, the tendency among innovative treatment technology vendors is to minimize the use of over-the-road vehicles. However, the technology would need to be sited near a major road/highway in the pre-construction stages to haul in large equipment. During the operations stages, a portion of traffic flow would be generated by shift workers. The majority of traffic would likely result from trucks needed to transport dredged material to processing facilities, then transport the processed material to final deposition.

The selected technology and site location would have a considerable effect on traffic impacts to local road networks. Where treatment involved multiple technologies that are not co-located, truck trips would be required to transport material between processing sites. Intermediate trips could be avoided by using a processing facility that employs multiple technologies in a treatment train approach. Truck traffic could be reduced by siting the processing facility on waterfront parcels to allow barge transport or on sites with railroad access. Technologies that involve highly efficient dewatering techniques, such as sand separation and/or high temperatures

(Cement-Lock, for example) also could reduce traffic generation and weight through the volume reduction intrinsic to the technologies.

The demand for services such as energy, water, and wastewater treatment for operation of innovative treatment technologies would vary depending on the technology and the volume of material processed by the facility. The sufficiency of local suppliers to provide such services would be determined in the siting and permitting processes.

Cultural Impacts

Innovative treatment technologies themselves (apart from composting, land tilling, and land farming, which require dredged material to be spread over large land areas) would not impact cultural resources. Potential impacts to cultural resources would not be anticipated if the innovative technology facilities were sited in previously impacted areas. In any case, potential impacts to cultural resources from any innovative treatment technology facility at a specific location would be reviewed and addressed during the permitting process and by the SHPO.

Socioeconomic Impacts

Innovative treatment technologies would likely be sited within existing industrial zones and/or facilities. Siting facilities in existing areas of compatible land use could alleviate or minimize adverse social impacts, EJ concerns, and visual impacts. Evergreen vegetation and visually appealing architectural designs are commonly used to reduce the adverse visual impacts of industrial facilities. In Europe and Scandinavia, these techniques have been used successfully to locate industrial high temperature processes in downtown areas of populated urban areas.

Beneficial Impacts

The use of innovative treatment technologies could potentially yield significant direct and indirect beneficial impacts through the generation of jobs and tax revenues. By neutralizing or removing contaminants from sediment, innovative technologies create products that can be used beneficially as manufactured soil for Brownfield remediation, public landscaping, highway projects, landfill daily cover and closure, structural fill, or a growing medium. Furthermore, many of these end products could partially offset project costs through tipping fees or as marketable commodities such as Portland cement replacement or potting soil. Recycling dredged material through treatment would allow the material to replace nonrenewable "greenfield" deposits of topsoil, sand, and shale.

The beneficial impacts of using soil manufactured from dredged material in Brownfield remediation would be cumulative as more fallow sites were remediated and returned to active use. The revenue generated from the fee charged for dredged material placement would provide an economic incentive to remediate contaminated sites. As blighted sites were restored, new businesses would be attracted, further increasing local economic growth. Costs to monitor, maintain, protect, and insure contaminated sites would be reduced or avoided.

Brownfields contribute pollutants to waterways through runoff and groundwater discharge. Remediation using soil manufactured from dredged material by innovative treatment technologies could reduce the discharge of contaminants to waterways and consequently reduce costs related to the impairment of resources, such as fisheries, and the human health effects of contaminants. Additionally, improved sediment quality resulting from reducing pollutant loading to waterways could reduce long-term dredging and sediment management costs.

5.2 IMPACTS ASSOCIATED WITH THE NO ACTION ALTERNATIVE

As discussed in Section 3.1, NEPA requires that an EIS evaluate the "No Action Alternative." Evaluation of the No Action Alternative involves assessing the environmental and socioeconomic effects that would result if the proposed action did not take place. These effects are then assessed and compared with the effects of the proposed action and the other "action" alternatives. As described in Section 3.1, the No Action Alternative for the Long Island Sound PEIS is defined as the absence of a comprehensive plan for dredged material management in Long Island Sound (i.e., no DMMP would be in effect).

Under the No Action Alternative, the current process of dredging and placement would continue to occur on a project-by-project basis, subject to available funds, and the long-term designated open-water placement sites (CLDS and WLDS) would expire as scheduled on April 30, 2016, or at some later time as determined by EPA for projects regulated under MPRSA. Projects regulated under the CWA would not be affected. In addition, the two USACE-selected sites (CSDS and NLDS) are scheduled to expire in December 2016. As a result, no open-water placement of MPRSA regulated dredged material projects could occur in Long Island Sound after December 2016.

Without available designated open-water placement sites for MPRSA-regulated projects in Long Island Sound, or practicable cost-effective alternative placement sites and methods, maintenance and periodic improvement of the region's waterways would become more costly and uncertain. However, several hypothetical scenarios might reasonably be considered. First, placement site authorization for private projects involving less than 25,000 CY of material would continue to be evaluated on a project-specific basis under CWA Section 404. Second, for projects subject to MPRSA § 106(f) (i.e., either Federal projects of any size or private projects involving greater than 25,000 CY of material), project proponents would need to pursue one or more of the following courses of action:

(1) Develop and utilize practicable and cost-effective land-based, in-harbor, nearshore, beneficial use, or CDF placement/use alternatives, depending on the size of project and nature of the material to be dredged
(2) Use an alternative open-water site, either inside or outside of Long Island Sound, that has been "selected" by the USACE (e.g., CSDS, NLDS, or another, newly selected site) and concurred with by EPA under MPRSA Section 103
(3) Use an existing designated site outside of the Long Island Sound study area (e.g., RISDS, HARS)
(4) Await EPA designation of a different placement site within Long Island Sound
(5) Cancel proposed dredging projects

The No Action Alternative for projects subject to MPRSA § 106(f) poses a different set of problems over the long term. The first No Action Alternative scenario identified above has short- and long-term limitations. Both New York and Connecticut have some limited land-based, in-harbor, nearshore, beneficial use, or CDF placement/use alternatives sites which could provide some capacity for dredged material placement, but these sites would not be reasonable, long-term alternatives to open-water placement (see Chapter 3 for the description of potential alternative sites evaluated in this PEIS). Although both state and Federal agencies are pursuing alternatives to open-water placement, the potential areas identified either do not have sufficient long-term dredged material placement capacity or are not cost-effective or practicable alternatives to open-water placement. For example, the estimated capacity of beneficial use and other land-based alternatives evaluated in this PEIS that could potentially accept suitable material that could otherwise go offshore is about 25 million CY; the currently available capacity at the four open-water alternatives in Long Island Sound is 248 million CY. For comparison, the total dredging needs of USACE and other Federal navigation projects within the Long Island Sound study area is projected to be almost 32 million CY. Complete reliance on land-based or beneficial use placement would also likely raise the cost and increase the duration of dredging projects, possibly rendering some infeasible. Impacts associated with the various types of land-based and beneficial use placement alternatives are described in Section 5.1.

For the second scenario above, involving the use of USACE-selected sites, such use is limited to no more than two five-year periods, as explained in Chapter 3. Over the long term, this approach would require the USACE to select sites as needed around Long Island Sound, or elsewhere, thus spreading any environmental effects throughout and possibly outside Long Island Sound. This would be contrary to the MPRSA principle that favors the continued use of historically used sites. In addition, as discussed above, under this approach CLDS and WLDS would soon become unavailable. To the extent that the use of these sites would be environmentally preferable to the use of other sites, this No Action Alternative scenario would preclude that outcome. Moreover, to the extent that other sites within the Sound were considered for selection by the USACE, the greater haul distances for projects located in the Central and Western Basins would increase the cost and duration of each project. This could potentially render many projects infeasible (see the discussion below for the fifth No Action Alternative scenario, which addresses the ramifications if necessary dredging in the central and western regions of the Sound were not implemented). Although of less significance, it is also worth noting that increased haul distances could also increase any risk of mishap in transit, increase project air emissions, and require greater fuel consumption. Finally, over the long term, this approach would pose the additional administrative difficulty of requiring multiple site selection studies.

With respect to the third No Action Alternative scenario, the currently existing EPA-designated placement sites located outside of the Long Island Sound study area are all too far away from most of the dredging projects located within Long Island Sound to constitute reasonable alternatives. Reliance on such sites would greatly increase the cost, duration, and transportation safety risk of dredged material placement projects from Long Island Sound. This would likely render the vast majority of dredging projects prohibitively expensive to conduct. As a result, needed dredging would not be able to take place (see the discussion below for the fifth No Action Alternative scenario, which addresses the ramifications if necessary dredging in the central and western regions of the Sound were not implemented).

The fourth No Action Alternative scenario identified above presents long-term uncertainty. An ongoing effort to designate a new placement site in New England involves a possible placement site designation in eastern Long Island Sound. The site alternatives under consideration are too far away to make them reasonable alternatives for dredging projects in the central and western regions of the Sound. It is also not yet known when the process will be completed, or what the results may be. No other site designation evaluation process is currently under consideration for Long Island Sound.

The fifth No Action Alternative scenario — simply canceling the majority of the dredging that would otherwise take place — would have adverse effects on navigational safety and marine-dependent commerce. It could also have adverse environmental ramifications if shoaling in the navigation channels resulted in more marine accidents and spills and forced the use of other transportation methods (such as truck and rail) to move products, which could result in greater air emissions, traffic congestion, and other impacts from increased truck traffic on the region's highways and roads.

The specific types of impacts that might arise from No Action Alternative Scenarios 2 through 5 are discussed in more detail below; impacts under Scenario 1 are described in Section 5.1 for the various alternative types. For all types of impacts associated with the selection of new open-water sites within Long Island Sound (Scenario 2), the level of impact would vary depending on the number of sites selected and the volume of dredged material placed. The existing conditions at the selected sites would first need to be assessed.

5.2.1 Physical Impacts

Physical impacts under Scenario 1 (develop and use alternatives other than open-water alternatives) are described in Section 5.1 for each alternative type.

Under the No Action Alternative, the selection of new open-water sites either within or outside of Long Island Sound (Scenario 2) could increase the potential for adverse environmental impacts because new open-water locations would likely be in areas where placement has not previously occurred. Sedimentation and erosion would be more likely under this scenario because material would be dispersed over a greater area within or outside of Long Island Sound. Under Scenario 3 (use an existing designated site) and Scenario 4 (await the designation of a different site), potential adverse impacts to sedimentation would likely decrease because less material would be placed in Long Island Sound. Erosion conditions, however, would remain unchanged, since erosion is based on the hydrodynamics of Long Island Sound. If projects were cancelled (Scenario 5), significant sedimentation and shoaling would occur in rivers and harbors. This would result in decreased water depths and potential changes in nearshore hydrodynamics.

5.2.2 Environmental Impacts

Environmental impacts under Scenario 1 (develop and use alternatives other than open-water alternatives) are described in Section 5.1 for each alternative type.

Under the No Action Alternative, the selection of new open-water sites within Long Island Sound (Scenario 2) could increase the potential for impacts to benthos, shellfish, fish, sediment quality, and water quality (specifically to the water column), since it is likely that material would be dispersed over a greater area or over new areas. In addition, there is a potential for increased bioaccumulation because the dispersion of dredged material across a greater area could expose more individual organisms or species to chemical concentrations, depending on the existing sediment quality at the selected sites. The extent of impacts would depend on the environmental quality at the selected sites.

The potential for impacts to marine and coastal birds and to marine mammals and reptiles would remain unchanged if newly selected sites were used under the No Action Alternative However, coordination with NMFS and USFWS would be necessary to assess potential impacts to these species, regardless of the placement scenario chosen. The potential for impacts on endangered or threatened species could either increase or decrease, depending upon the use of the selected site, since each alternative site could have different ESA listed species. As discussed in Chapter 4, endangered and threatened species likely to be present within Long Island Sound on more than an occasional basis are the Atlantic sturgeon and several species of turtles. Coordination with NMFS and USFWS would be necessary to assess potential impacts to these species regardless of the placement scenario chosen.

The potential for adverse environmental impacts to benthos, shellfish, fish, marine and coastal birds, marine mammals and reptiles, water quality, sediment quality, and bioaccumulation potential would remain unchanged under Scenario 3 (use designated sites outside of Long Island Sound), Scenario 4 (await EPA designation), or Scenario 5 (cancel dredging projects) because less material would be placed in Long Island Sound under these scenarios. The potential for impacts on endangered or threatened species could either increase or decrease, depending upon the cancellation of projects. As discussed in Chapter 4, endangered and threatened species likely to be present within Long Island Sound on more than an occasional basis are the Atlantic sturgeon and several species of turtles. Coordination with NMFS and USFWS would be necessary to assess potential impacts to these species regardless of the placement scenario chosen.

Some increased level of air emissions could result from vessels or vehicles used to haul dredged material to a placement site. If designated open-water placement sites were not available, leading to greater land-based placement (Scenario 1), air emissions could increase under the following circumstances: (1) emissions resulting from equipment needed to transfer material from barges to dewatering sites and then to trucks, and (2) emissions resulting from the large number of truck trips needed to transport the material on land. Obviously, the level of emissions would vary depending on the distances trucks would have to travel to reach land-based placement site(s). In addition, heavy construction equipment would generate and emit pollutants during placement on land. Activity and equipment would have to comply with Connecticut Air Pollution Control Regulations[1], Vehicle Emission Standards[2], and Fugitive Dust Regulations[3] to minimize impacts. In addition, if no open-water sites were used and land-based placement became necessary, odor problems could result depending on how the materials were handled and where they were placed in relation to sensitive receptors.

If the USACE selected other open-water sites in the region (Scenario 2), the travel distances, and therefore emissions, for placement would be similar to current conditions. If open-water sites

[1] Connecticut Air Pollution Control Regulations: § 22a-174 of the CGS.
[2] Connecticut Air Pollution Control Regulations: § 22a-174-27.
[3] Connecticut Air Pollution Control Regulations: § 22a-174-18(b).

much farther away had to be used for placement (Scenario 3), the longer vessel trips could result in greater air emissions due to the need to use larger barges and more powerful tugs with larger engines. Under Scenarios 2 and 3, dust and volatilization would not occur and there would be no long-term effects on air quality because the material would be placed under water. Scenario 4 (await EPA designation) and Scenario 5 (cancel dredging projects) would decrease air emissions associated with the transport and placement of dredged material in Long Island Sound.

5.2.3 Infrastructure Impacts

Infrastructure impacts under Scenario 1 (develop and use alternatives other than open-water alternatives) are described in Section 5.1 for each alternative type.

Under the No Action Alternative, the selection of new open-water sites within Long Island Sound (Scenario 2) could increase impacts to infrastructure resources because placement would occur over a greater area within the Sound. Proposed dredged material placement would likely require additional investigations of infrastructure resources at newly selected sites. With regard to placement at previously used sites within Long Island Sound, impacts to infrastructure resources would likely remain unchanged from current conditions, as these sites would have undergone previous evaluations for the presence of these resources. Under Scenario 3 (use designated sites outside of Long Island Sound), Scenario 4 (await EPA designation), or Scenario 5 (cancel dredging projects), the potential for adverse impacts to infrastructure resources would remain unchanged because less material would be placed in Long Island Sound under these scenarios.

5.2.4 Cultural Impacts

Cultural impacts under Scenario 1 (develop and use alternatives other than open-water alternatives) are described in Section 5.1 for each alternative type.

Under the No Action Alternative, the selection of new open-water sites within Long Island Sound (Scenario 2) would potentially increase impacts to historic and archaeological resources because placement would occur over a greater area within the Sound. Proposed dredged material placement would likely require additional investigations of potential historic and archeological resources at newly selected sites. With regard to placement at previously used sites within Long Island Sound, impacts to historic and archaeological resources would likely remain unchanged from current conditions because these sites would have undergone previous evaluations for the presence of these resources. Regardless of the placement option selected, coordination with SHPOs and Tribal Historic Preservation Offices would be required. Under Scenario 3 (use designated sites outside of Long Island Sound), Scenario 4 (await EPA designation), or Scenario 5 (cancel dredging projects), the potential for adverse impacts to historic and archaeological resources would remain unchanged because less material would be placed in Long Island Sound under these scenarios.

5.2.5 Socioeconomic Impacts

The regional economic impacts under the No Action Alternative were assessed separately and were estimated by modeling these impacts assuming a "worst-case" scenario—complete cessation in dredging activity over a 20-year period (USACE (2010)). In essence, the assumption used to assess socioeconomic impacts is similar to Scenario 5 of the No Action Alternative for the assessment of physical, environmental, infrastructure, and cultural impacts. As described in Section 4.20.1, marine transportation provides the largest contribution to GSP (59%) for all activities analyzed, followed by recreational boating (22%).

Under the No Action Alternative, socioeconomic impacts would accumulate over time as shoaling continued and vessels lost access to harbors and waterways. Impacts on marine transportation and recreational boating would account for the greatest loss in economic activity, together representing 93% of the estimated reduction in GSP. In addition, ferry-dependent tourism would be expected to bear a somewhat disproportionate impact, accounting for 4% of the estimated loss in annual GSP for the study region. Other impacts not quantified in this analysis include increased costs related to tidal delays for cargo traffic and an increased likelihood of vessel collisions and oil spills. In addition, loss of access to ports could cause commercial and recreational fishermen to abandon fishing altogether, which would have negative social and cultural impacts on the communities that rely on such activity. Losses in annual GSP in the 20th year of the No Action Alternative are anticipated to be approximately \$853 million, or approximately 15% of the current regional GSP, from navigation-dependent economic activities. Eastern and western Connecticut, as well as western Long Island, would likely bear the largest impacts in terms of GSP, each experiencing more than \$200 million in reduced GSP after 20 years (Table 5-2).

Table 5-2. Regional Economic Impacts in the 20th Year of the No Action Alternative (2009 dollars)[1].

Region[2]	Annual Output (millions)	Annual GSP (millions)	Annual Employment [3]	Annual Tax Revenues (millions)[4]
Rhode Island	-$41.4	-$12.5	-215	-$3.5
Eastern Connecticut	-$386.8	-$237.8	-3,525	-$71.9
Western Connecticut	-$338.1	-$209.8	-2,554	-$65.1
New York Mainland	-$57.9	-$36.9	-461	-$11.7
Western Long Island	-$450.4	-$232.6	-1,644	-$68.7
Eastern Long Island	-$108.6	-$68.5	-1,284	-$22.6
All Long Island Sound[5]	-$1,467.8	-$853.0	-9,655	-$262.5

[1]All figures reported represent the sum of the direct impacts (output of navigation-dependent industries themselves), indirect impacts (output of other industries that supply goods and services to those industries), and induced impacts (changes in household consumption due to employment and income changes from direct and indirect effects) for each category.

[2]Regions are defined as follows: Rhode Island--Washington County; Eastern Connecticut--Hartford, Middlesex, and New London Counties; Western Connecticut--Fairfield and New Haven Counties; New York Mainland--Westchester and Bronx Counties; Western Long Island--Kings, Queens, and Nassau Counties; and Eastern Long Island--Suffolk County. Note that Queens and Kings counties are included only for purposes of measuring indirect and induced effects. Navigation -dependent activity on waterways in these counties is not considered when measuring direct effects. Similarly, waterways in Washington County, outside of Westerly and Block Island, are not considered when measuring direct effects.

[3]Employment is defined by the Bureau of Labor Statistics as "the total number of persons on establishment payrolls employed full or part time who received pay for any part of the pay period that includes the 12th day of the month" (BLS, 2015). Temporary and intermittent employees are included Data exclude proprietors, those who are self-employed, unpaid family or volunteer workers, farm workers, and domestic workers. Because fishing employment is likely to be underestimated in BLS data, we utilize an alternative method (combining data on ex-vessel revenues in the commercial fishing sector with an estimate of output per worker) to estimate employment in this industry. Nonetheless, this estimate may be skewed, and employment, payroll, and output for the commercial fishing sector may be understated.

[4]The tax impacts include all payments to government, and represent the sum of direct, indirect, and induced taxes paid by employees, businesses, and households. As such, tax impact measurements somewhat overlap with other measures and should not be summed (e.g., value added and output include payments made by industries to payroll taxes).

[5]Note that due to leakage effects (i.e., economic activity across study regions that is not captured in the models run for each region but is captured in the larger Long Island Sound area model), the sum of the output, GSP, and annual tax revenue values reported for the six sub-regions is less than the activity reported for the study area as a whole. The difference in measured impacts of the No Action Alternative varies from 5% to 8%, depending on the output measure. In the case of employment, however, the figures reported for the six regions sum to a value greater than that indicated for the Long Island Sound study area. This anomaly may result from independent specification of the regional purchase coefficients within each IMPLAN model (i.e., regional purchase coefficients for one or more sub-regions that are different than the regional purchase coefficient for the study area as a whole). In addition, the output per worker that IMPLAN specifies may be lower in some sub-regions, causing the model to estimate greater relative employment impacts within these regions than for the study area as a whole.

5.3 IMPACTS ASSOCIATED WITH PLACEMENT ALTERNATIVE SITES

This section addresses the potential impacts to the physical, environmental, infrastructure, and cultural resources that could occur as a result of dredged material placement at each of the potential alternative sites. The site-specific resource data used to assess these impacts are summarized in Chapter 4 of this PEIS. Site-specific data are currently not available to support the assessment of socioeconomic impacts at each potential placement location. While general impacts by alternative type are provided in USACE (2015a), future use of these alternative sites for the placement of dredged material would require a detailed assessment of the impacts at the site on a project-by-project basis.

5.3.1 Open-Water Placement Alternatives

Site-specific impacts associated with the placement of dredged material at the open-water placement alternative sites are described below.

Unconfined Open-Water Placement

Western Long Island Disposal Site

Physical Impacts
The seafloor at the WLDS grades into an east-to-west axial depression, or trough, in the lower half of the site. Water depths range from 75 ft to 85 ft along the northern boundary, down to a 118-ft-deep cut of the axial depression, and slopes up to 98 ft along the southern boundary corners and up to 75 ft in the middle of the southern boundary to a sediment-covered incised platform (ENSR, 2007). Given the depths of the site and limitations on mound height, dredged material placement at WLDS would not impact surface waves.

WLDS is located in a depositional area where the seafloor consists of sandy fine-grained sediment with areas overlain with historic and more recently placed dredged material consisting of sand-silt-clay deposits. The site is flanked by transitional and sand habitats. The sediment properties are similar to ambient sediments in the vicinity of the site. Potential impacts to WLDS are unlikely given the previous changes from historic dredged material at the site and the lack of major differences in the dredged material and ambient sediments.

Sediment accumulation in the area is indicative of a low current regime. In addition, the shoal areas and lack of furrows in the vicinity of WLDS appear to reflect the complex topography and lack of directionally stable currents (ENSR, 2007). Impacts to bottom currents are unlikely due to management of the site and limited currents at the site. There are potential impacts to sediment transport during extreme storm events and/or when high easterly winds combine with spring tidal currents, depending on dredged material mound height and placement location. However, modeling has shown that 2- and 10-year storms would not erode bottom sediments at WLDS or cause sediment transport (EPA, 2004). Modeling studies have also shown that limiting mound height can prevent sediment transport (EPA, 2004).

Bathymetric surveys conducted at WLDS before Hurricane Gloria (August 1985) and afterward (October 1985) revealed no large-scale changes in the bottom topography at the site as a result of the storm. Subsequent monitoring surveys also showed long-term stability of the dredged material mounds and no evidence of erosion of dredged material (USACE (1989); ENSR (2005b); ENSR (2007)).

Environmental Impacts

Burial by dredged material would cause short-term impacts to the abundance and diversity of the benthic community at WLDS. Recovery to levels and species similar to pre-placement could be delayed or prevented if dredged sediment characteristics were different from native material. There is a potential for short-term impacts to the benthic community (respiration and feeding) associated with water quality impairment from the sediment plume following placement. Recolonization to pre-placement levels would be likely, and no long-term effects would be expected as long as dredged material placed at the site was similar to the sandy and fine-grained sediments currently at the site.

The potential area of direct impacts (death and burial) to the benthic community at the WLDS Alternative is estimated to be from 2 to 7.6 acres per year based on average annual mound sizes at the existing WLDS (EPA, 2004). This area represents much less than 0.1% of the available deep fine-grained habitat in this part of the Western Basin (over 9 nmi^2). The direct impacts to the community in an area of this scale are not expected to cause a measurable reduction in the population of any of the species potentially affected within the Western Basin.

Short-term impacts to shellfish could occur from the placement of dredged material at WLDS. The primary shellfish resource inhabiting WLDS is the American lobster, which feeds and burrows there and has been found to occur in high abundance at the site relative to abundances observed in other parts of the Western Basin (EPA (2004); Giannini & Howell (2010)). Dredging windows restrict placement during vulnerable life stages of lobsters (EPA, 2004). Placement of dredged material at WLDS would not be expected to cause major alterations to the seafloor habitat that is currently available for lobster, crabs, or potential bivalves at WLDS. Minor changes in topography and potential organic content could improve shellfish habitat by creating diversity in seafloor conditions and supporting prey populations. Placement would disrupt the habitat and result in short-term impacts to shellfish resources in the immediate area due to burial. Water quality impacts of the sediment plume could potentially impact shellfish filtration and respiration.

Short-term impacts to plankton could occur from dredged material entrainment and sediment plumes in the water column. Most of the discharged dredged material would quickly fall to the seafloor, which could entrain a small area of planktonic organisms (e.g., phytoplankton, zooplankton, and larval stages of fish and invertebrates) and displace others with the movement of water. Increased turbidity resulting from discharged dredged material would temporarily alter water quality, which would have potential short-term impacts on plankton. The impact could be detrimental or beneficial, depending on the planktonic species. The amount of organisms affected would be small compared to the size of the overall community at WLDS.

The majority of finfish species in the WLDS area are migratory, and recovery to levels similar to pre-placement has been documented at this site and throughout Long Island Sound (EPA, 2004). The predicted direct impacts (death or burial) of placement on fish populations in the western Sound would most likely include the potential burial of juvenile red hake within the central footprint of the mound, although some direct impacts would be possible with any demersal (bottom-water-dwelling) fish present at the site. Demersal fish species that could be present during some portion of the period when placement could occur include winter flounder, windowpane flounder, fourspot flounder, and fourbeard rockling (EPA, 2004). The impacts resulting in habitat disruption would be short term. Water quality impacts associated with temporary increased turbidity could potentially have direct short-term impacts on fish respiration.

Indirect impacts would likely include temporary displacement of finfish from benthic foraging areas and refuge on fine-grained habitat from late fall to early spring (October to April), as well as occasional displacement of migrating adults in spring and adults and young of the year in fall. The species most likely to experience indirect effects include cunner, winter flounder, and striped searobin. Other species that could also experience indirect effects include fourbeard rockling, fourspot flounder, scup, smooth dogfish, summer flounder, tautog, weakfish, and windowpane flounder. These predictions are based on the migration of the majority of the finfish species out of western Long Island Sound for the period when placement usually occurs (winter months) and the life history patterns and relative abundance of selected species (EPA, 2004).

Placement of dredged material at WLDS would not be expected to cause major alterations to the seafloor habitat at WLDS. Minor changes in topography and potential organic content could improve demersal fish habitat by creating diversity in seafloor conditions and supporting prey populations.

All of Long Island Sound is mapped as EFH, and there are three listed endangered fish species that potentially could occur at WLDS. There are 15 Federally managed species according to the NOAA EFH square designations. Previously, NMFS and USWFS concurred with the findings of the 2004 Final EIS designation of the WLDS and CLDS stating that dredged material placement at these sites is not likely to adversely affect listed species or EFH (EPA, 2005).

About 20 species of marine mammals and reptiles have been identified as possibly occurring at WLDS, which includes five endangered or threatened species of both whales and sea turtles. Sea turtles, whales, and other marine mammals typically migrate into Long Island Sound from the Atlantic Ocean and would thus have a higher probability of occurring in the eastern portion near ocean waters than in the Western Basin where WLDS is located. Open-water placement could potentially impact marine mammals and reptiles, either directly by vessel strikes or indirectly by harassment during placement due to noise and sediment discharge. Temporary sediment plumes could also cause these creatures to avoid the local area. In the designation of WLDS, USFWS noted that "no habitat in the project impact area is currently designated or proposed 'critical habitat' in accordance with provisions of the Endangered Species Act (87 Stat. 884 as amended; 16 U.S.C. 1532 et seq.)". The potential for vessel strikes is limited by the slow speed of tugboat and barge operations. Recent ship speed reductions have been found to be effective in reducing strikes to whales (Conn & Silber (2013); NOAA (2013)). No strikes to endangered or threatened species or to dolphins and seals are known to have occurred in the history of the DAMOS program. Potential adverse impacts would be limited and of short duration.

The primary impacts to water quality following dredged material placement at WLDS would be associated with the residual particles that remain suspended from minutes to a few hours after most of the sediment has reached the seafloor. These intermittent,short-term impacts to water quality could potentially include light reduction, interference with biological processes, and contaminant exposure. Suspended sediment could also potentially promote productivity of specific species by serving as a food source (Wilber & Clarke, 2001). The impacts of suspended solids on DO water column concentrations would likely be minimal (mostly in the lower part of the water column) and short-term.

Low DO conditions are a widespread problem in western Long Island Sound and in parts of the Central Basin during summer. Studies of Welsh & Eller (1991) and others have shown that the sediment oxygen demand imparted by the sediments of western Long Island Sound does not significantly influence or drive the observed hypoxic conditions. Instead, the hypoxia is related to the large input of nutrients to the water column and the resultant eutrophic conditions in the water column coupled with summer stratification. Thus, it is not expected that the sediment oxygen demand exerted by dredged material placed at WLDS or any of the alternative sites would have significant impact on the hypoxia in this region or in other areas of Long Island Sound. In addition, dredged material placement usually occurs during the fall and winter months when hypoxic conditions are not likely to exist. The spatial map of the frequency of low-DO years from 1991-2013 (see Figure 4-22) supports the lack of impact on DO conditions, as the WLDS area is within the regional trend for deeper waters and is not anomalously higher than other areas. The links between anthropogenic and terrigenous inputs of organic carbon and sediment oxygen demand and anoxic conditions within sediments are complex (Cuomo, et al., 2014). Seasonal occurrences of anoxic sediments have been mapped in western Long Island Sound and could potentially contribute to a feedback loop with depressed oxygen levels in bottom waters, but WLDS has not been mapped as a hot spot of sediment TOC (Cuomo, et al., (2005); Poppe, et al. (2000)).

For WLDS, model simulations have shown that the vast majority of released dredged material settled to the bottom in close proximity to the point of release (EPA, 2004). The higher-than-typical current conditions chosen for the simulation were the most significant factor in determining residual plume conditions. This might be expected given that a current of 0.9 ft per second would cross half the width of WLDS in less than one hour, and release was at the center of the site. All dilutions were well within the toxicity criteria limits after the four-hour initial mixing period. However, toxicity criteria exceedances occurred when the plume passed out of the site boundaries under high currents, which occurred approximately 90 minutes after release and returned to permissible levels within another 20 minutes beyond the site boundary (EPA, 2004). The results suggest that dilution of contaminants below the prescribed 1/100th LC_{50} level (Median Lethal Concentration) for the worst-case scenario could potentially be achieved simply by adjusting the management approach—either by limiting barge size, limiting operations to times other than during spring tide, positioning the release point according to the ambient currents, or expanding the site boundaries.

Many metals (silver, cadmium, copper, nickel, lead, and zinc) appear to occur in a form that is not biologically available, and laboratory toxicity test data indicate that sediments from WLDS are not acutely toxic to amphipods. Bioaccumulation rates for lobster and finfish at WLDS were generally within the range of levels in similar organisms in other non-placement areas of Long Island Sound. Advanced benthic recovery has been documented following dredged material placement. These results show that the sediment quality within the sites is not significantly degraded and that irreversible or significant adverse impacts from the placement of dredged material in the sites have not occurred (EPA, 2004).

For the purpose of future placement activities, any dredged material taken to the alternative sites would be tested and evaluated in accordance with applicable regulations, as described in the Regional Implementation Manual (EPA and USACE, 2013). As a result, dredged sediments that are toxic or that contain statistically significant levels of contaminants most likely would not be found suitable for unconfined open-water placement without further testing that demonstrated limited bioaccumulation. Therefore, adverse effects to sediment quality as a result of dredged material placement would likely not occur at WLDS.

Impacts to local air quality are expected to consist mainly of exhaust fumes from tugs and other equipment used during operations. These impacts would be intermittent and short in duration and would have to comply with air quality regulations. Tugs would generate some noise while transporting the barges, but this impact would likely not be substantially different from background noise levels in the area.

<u>Infrastructure Impacts</u>
The open-water placement of dredged material at WLDS would not impact most infrastructure resources (e.g., mooring areas, ports, coastal structures, cable/power/utility crossings, and aquaculture) because these are not present at the site. The temporary transit of barges from harbor regions to and from the alternative site could potentially cause short-term impacts by displacing shipping as well as recreational and commercial vessels at WLDS and/or the transit area. Alteration of bottom depths could also potentially impact navigation. However, navigational channels are not present at WLDS, and management of dredged material placement at the site would ensure that adequate water depths were maintained to minimize impacts to navigation.

<u>Cultural Impacts</u>
No cultural resources (e.g., shipwrecks, archaeology sites, and historic districts) exist at the WLDS Alternative site; therefore, no impacts to these resources would occur. The only potential visual impacts would be of short duration as vessels and barges traveled to and from the alternative site.

Central Long Island Disposal Site

<u>Physical Impacts</u>
The ambient seafloor at CLDS is a gently sloping plane from a depth of 59 ft at the northwest corner to 72 ft in the southeast corner, with distinct dredged material mounds from past dredged material placement activities rising to depths as shallow as 46 ft (AECOM, 2013). The site is not as deep as WLDS and has a less complex, more even natural topography. Given the depths of the site and management limitations on mound height, dredged material placement at CLDS would not impact surface waves.

Located in a depositional area, CLDS has fine-grained ambient sediments with sand-silt-clay deposits of historic and more recently placed dredged material. The sediment properties at CLDS are similar to, though in some areas more sandy than, ambient sediments in vicinity of the site. Potential physical impacts to CLDS would be unlikely given the previous changes from historic dredged material at the site and the lack of major differences in the dredged material and ambient sediments.

Sediment accumulation and a low current regime that are characteristic of deep areas of the Western and Central Basins are also observed at CLDS. However, currents are faster than observed at WLDS, and there are large, east-west sedimentary furrows at CLDS that appear to be generated by mobilization of the seafloor during infrequent storms or extreme tidal events (Poppe, et al., 2002). Acoustic surveys from 1997, 2000, 2005, and 2011 show that the furrows have been stable over time, providing strong evidence for the lack of sediment transport at the site (ENSR (2007); AECOM (2013)). The processes responsible for the formation of the furrows either were not actively modifying these sedimentary features or were not modifying them at a scale observable in acoustic images within this 14-year timeframe (ENSR, 2007). This also suggests that mound formation at CLDS has not impacted regional flow patterns and sediment transport, as changes to the seafloor topography would be evident over time.

There are potential impacts to sediment transport during extreme storm events and/or when winds combine with spring tidal currents, depending on dredged material mound height and placement location. In addition, waves tend to be larger at CLDS than at WLDS under the most frequent wind conditions (from the west-southwest). Under storm conditions that typically have winds from the east or northeast, wave heights tend to be similar for the Western and Central Basins. Model predictions of sediment transport show that when dredged material mounds are several feet high, waves and currents associated with 2- and 10-year storms would not erode bottom sediments (EPA, 2004). Modeling has also shown that mound placement and limited mound heights can reduce the potential for erosion (EPA, 2004). These results are consistent with survey observations of historical sediment stability.

Environmental Impacts

The benthic community at the CLDS Alternative consists primarily of the three major taxonomic groups, Annelida, Mollusca, and Crustacea. Many species belonging to these groups have shown the ability to burrow up through deposited dredged material. At the CLDS Alternative, the numbers of species per sample and the diversity of species were found to be similar to those at WLDS (EPA, 2004). Impacts from dredged material placement at CLDS would likely be similar to impacts at WLDS, with short-term impacts to the benthic community due to burial and potential water quality impairment.

The potential area of direct impact to the benthic community at the CLDS Alternative is estimated to be between 85,000 and 1,039,000 ft^2 based on average annual mound sizes at the existing CLDS (EPA, 2004). This area of between 2 and 24 acres represents much less than 0.1% of the available deep mud habitat in this part of the Central Basin (over 40 nmi^2).

Similar to WLDS, there would likely be potential short-term impacts to shellfish from dredged material placement at CLDS. According to NOAA (2014), the CLDS is within 2.2 mi of

American lobster and blue crab habitat. Past trawl and benthic surveys have observed lobsters and the potential for hard clams at CLDS; however, no evidence of the presence of hard clams was found (EPA, 2004). Temporary potential impacts would include burial of shellfish and water quality impairments as well as potential benefits from increased variation in topography.

Similar to WLDS, there is the potential for short-term impacts to plankton from dredged material entrainment and sediment plumes in the water column at CLDS.

The location of the CLDS Alternative in the Central Basin of Long Island Sound places the site in an area with broadly distributed fish resources. The central area of the Sound has relatively homogeneous bottom habitat and encompasses an area with some open ocean characteristics (long fetch, areas of deep water) and access to nearshore resources and reef habitats. The predicted direct impacts of dredged material placement at CLDS would most likely include red hake within the central footprint of the mound, although some direct impacts would be possible with any demersal fish present at the site during discharge. Demersal fish species that could be present during some portion of the period when placement occurred include summer flounder, winter flounder, windowpane flounder, fourspot flounder, and fourbeard rockling. The direct impacts of death and burial on this scale would not be expected to cause a measurable reduction in the regional population of any of the species potentially affected within the Central Basin (EPA, 2004).

Indirect impacts would likely include temporary displacement of finfish from benthic foraging areas and refuge on fine-grained habitat from late fall to early spring (October to May), as well as displacement of migrating adults in spring and adults and young of the year in fall. The species most likely to experience indirect effects include red hake, scup, and winter flounder. Winter flounder could be present during placement due to the overwintering of young flounder and spawning migration into the Sound of mature and immature flounder. Other species that could experience indirect effects include black sea bass, bluefish, butterfish, fourbeard rockling, fourspot flounder, hogchoker, silver hake, smooth dogfish, striped searobin, summer flounder, tautog, weakfish, and windowpane flounder. Bluefish could use a sediment plume to increase predation as the turbid water can hide their presence (and the presence of prey). This finding is based on the migration of most finfish species out of central Long Island Sound for the period when placement usually occurs, and the life history patterns and relative abundance of selected species (EPA, 2004). These indirect impacts would be localized and short-term and would be partially offset by increased topographic relief within the site and recolonization by benthic food sources.

Winter flounder, a species with an above average occurrence at the CLDS Alternative, may not migrate out of the central Sound in winter and may be at the greatest risk of adverse impacts. They are most likely to experience some disruption of food sources from the placement of dredged material; however, they could also be attracted to disturbed sediments and recolonizing benthos or they could prey upon scavengers attracted to the disturbed sediments. In the fall, weakfish are also abundant and could overlap with a part of the placement season; they may avoid the water column near dredged material discharge. However, weakfish do migrate out of the Sound from December to April and may miss most dredged material placement (EPA, 2004).

Placement of dredged material at the CLDS Alternative is not expected to cause major alterations to the seafloor habitat. Minor changes in topography and fresh sediment could improve demersal fish habitat by creating diversity in seafloor conditions and supporting prey populations.

All of Long Island Sound is mapped as EFH, and there are three listed endangered fish species that potentially could occur at CLDS. There are 17 Federally managed species according to the NOAA EFH square designations. Previously, NMFS and USWFS concurred with the findings of the 2004 Final EIS designation of the WLDS and CLDS stating that the dredged material placementat these sites is not likely to adversely affect listed species or EFH (EPA, 2005).

About 20 species of marine mammals and reptiles have been identified as possibly occurring at CLDS, which includes five endangered or threatened species of both whales and sea turtles. Open-water placement could potentially impact marine mammals and reptiles, either directly by vessel strikes or indirectly by harassment during placement due to noise and sediment discharge. Temporary sediment plumes could also cause these creatures to avoid of the local area. In the designation of CLDS, USFWS noted that "no habitat in the project impact area is currently designated or proposed 'critical habitat' in accordance with provisions of the Endangered Species Act (87 Stat. 884 as amended; 16 U.S. C. 1532 et seq.)". The potential for vessel strikes is limited by the slow speed of tugboat and barge operations. Recent ship speed reductions have been found to be effective in reducing strikes to whales (Conn & Silber (2013); NOAA (2013)). No strikes to endangered or threatened species or to dolphins and seals are known to have occurred in the history of the DAMOS program. Potential adverse impacts would be limited and of short duration.

Water quality impacts at CLDS would likely be similar to those at WLDS. As with WLDS, CLDS model simulations showed that the high current conditions chosen for the simulation were the most significant factor in determining the spread of the residual plume. The dilutions were all well within the toxicity criteria limits after the four-hour initial mixing period. Toxicity criteria exceedances occurred when the plume passed out of the site boundaries, approximately 90 minutes after release, although the dilution returned to permissible levels within another 30 minutes beyond the site boundary. As with WLDS, the spring tide current (the worst case) carried the plume over the short travel distance from the site center to the site boundary. Unlike WLDS, however, this was the case for both barge sizes. The smaller barge size was not small enough to sufficiently decrease the time needed for dilution. The percent volume of clumps and percent volume of free water used in the simulations were not significant in the ranges simulated. For CLDS, the model results suggest that dilution of contaminants below the prescribed 1/100th LC_{50} level for worst-case projects could potentially be achieved by adjusting the management approach—either by further limiting barge size, limiting operations to times other than during spring tide, positioning the release point according to the ambient currents, or expanding the site boundaries (EPA, 2004).

Impacts on sediment quality at CLDS are not likely to occur for the same reasons placement of dredged material would not likely impact the area at WLDS. Several metals do not appear to be in biologically available form; toxicity test data indicate that sediments are not toxic to amphipods. Bioaccumulation rates for clams, worms, finfish, and lobster were generally in the range of levels in other, non-placement areas of Long Island Sound. Advanced benthic recovery has been documented following dredged material placement. Continued placement of dredged material at CLDS could improve sediment quality at the site. These results show that the sediment quality within the sites is not significantly degraded and that irreversible or significant adverse impacts from the placement of dredged material at the sites have not occurred (EPA, 2004).

Air quality and noise impacts at CLDS (as at WLDS) would likely be short-term and minor, would comply with regulations, and would be within background levels for the area.

Infrastructure Impacts

The open-water placement of dredged material at CLDS would not impact most infrastructure resources (e.g., mooring areas, ports, coastal structures, cable/power/utility crossings, and aquaculture) because these are not present at the site. Navigation channels are present at CLDS. The temporary transit of barges from harbor regions to and from the alternative site would cause short-term impacts by displacing shipping vessels and recreational and commercial vessels at CLDS and/or the transit area. Alteration of bottom depths could also potentially impact navigation. However, management of dredged material placement at the site would ensure that adequate water depths were maintained to minimize impacts to navigation.

Cultural Impacts

No cultural resources (e.g., shipwrecks, archaeology sites, and historic districts) exist at the CLDS Alternative site; therefore, no impacts to these resources would occur. The only potential visual impacts would be of short duration as vessels and barges traveled to and from the alternative site.

Cornfield Shoals Disposal Site

Physical Impacts

The CSDS, located in the Eastern Basin south of the mouth of the Connecticut River, is the only site in a non-depositional area managed as a dispersive site (dredged material is allowed to be transported out of the site boundary). The CSDS is the deepest of the four open-water placement alternatives, with water depths ranging from 151 ft in the northeast corner to a maximum depth of 189 ft in the southwestern quadrant where there is a depression (ENSR, 2005a). The predominant topographic features are a smooth, sandy bottom and bedforms oriented in an east-west direction that gently slope from northeast to southwest The sand deposits at the mouth of the Connecticut River form a shoal complex that is reworked by tidal currents (Knebel & Poppe, 2000). Because sediments have not been observed to substantially accumulate at the CSDS (ENSR, 2005a), and because the water depth is greater than other alternatives, no impacts to currents or waves are expected to occur from dredged material placement at CSDS.

CSDS has received dredged material primarily from the Connecticut River and harbors adjacent to the river. Connecticut River navigation channel sediments tend to consist of sand similar to CSDS sediments, while the harbors and marinas have finer sediments. Although there could be potential impacts to the site if dredged material had different grain size characteristics from the ambient sediments, CSDS is a site with active sediment transport; dredged materials placed there are not confined within the site and do not accumulate significant amounts within it. Any potential impacts from differences in sediment type would be short-term until the placed sediments were reworked. There could be potential impacts on sediment type to the west of the site due to the prevailing tidal transport mechanism.

The coarse particle size of sediments (sand and gravel) at the site are a result of high-energy physical processes from tidal currents, atmospheric storms, and the Connecticut River outflow in the area. CSDS is located in a narrow part of Long Island Sound, which constricts ocean tidal currents through the Eastern Basin, increasing flow rates. The high energy at the CSDS results in a westward sediment transport that also disperses placed dredged material to the west (ENSR (ENSR, 2005a); Wiley (1996)). Observations of clay nodules from glacial lake deposits also provide evidence of scouring at the site (SAIC, 1988). Sediment transport was not modeled for the CSDS site as part of the 2003 EPA study (EPA, 2004). Unlike WLDS and CLDS, it is expected that most of the dredged material would be transported from the site following discharge due to the greater depths and high-energy regime at CSDS.

During a current meter deployment at CSDS in the early 1990s, two major storms passed over the area (Wiley, 1996). On August 19, 1991, Hurricane Bob produced maximum wind speeds of 45 knots. During the hurricane, the data from the mid-water meter showed that the mid-day flood velocity was reduced by more than half and the succeeding flood tide current was normal. Then, at the end of October 1991, what became known as the "Perfect Storm" occurred, with sustained winds of 40 knots over October 30 and 31. The National Weather Service determined that storm to be a 100-year storm; therefore, the potential for erosion could have been high. During this "Halloween" storm, the current meters showed no change in current strength, yet the net near bottom drift shifted from a normal west-southwest direction to directly west. More recent current meter deployments and modeling (2013) identify the area of CSDS as one of the highest areas of bottom stress in eastern Long Island Sound during fair weather and storm conditions (O'Donnell, 2014). The timing of storms and wind directions with respect to tidal cycles appears to be critical to result in bottom current impacts at this deep water site.

<u>Environmental Impacts</u>
Impacts to the benthic community at CSDS would be fewer than those at WLDS or CLDS, but they would occur over a greater area for two main reasons: the dredged material is expected to be dispersed much more by currents at the site, and management practices deliberately do not target a specific area for placement. In other words, the same size barge of dredged material would result in a small and thicker deposit at the other sites compared to a larger and thinner deposit at CSDS, and deposits would occur over a larger area; therefore, different burial impacts would result. Potential increased organic matter and reduced grain size temporarily available at the site could have a beneficial impact by serving as a food source for benthic organisms. The changes to the sediment could also potentially delay or cause changes to benthic recovery rates. Because the site experiences routine disturbance from tidal currents, impacts could be less than at other sites that do not experience routine disturbances. The amount of benthic data available at CSDS is less than at the other sites, which makes it more difficult to evaluate conditions over time. However, increased species richness could be expected because of the coarser sediments at the site and the east-west gradient of increasing species richness that has been observed throughout Long Island Sound. The richness of species occurrence is likely due to the larger potential species pool given connections to Block Island Sound, the Atlantic Ocean, and coastal areas. Increased richness could aid in the recovery times of benthic invertebrates.

Potential short-term impacts to shellfish from dredged material placement could include burial and temporary water quality impairments. These impacts would be similar to those at WLDS and CLDS; however, the burial impacts may be less likely and would occur over a larger area of the site due to dispersal by currents and the lack of mound formation or target areas for placement. Habitat mapping indicates that the American lobster, blue crab, blue mussel, horseshoe crab, and softshell clam could occur at CSDS (NOAA, 2014). Surveys in 2000 observed lobster at the site, though they were less abundant than at other sites (EPA (2004), Appendix H-7). Concerns have been raised about shellfish beds located about 1.2 mi north of CSDS on the north side of Long Sand Shoal. In response, studies on currents at the site and comparative bathymetric surveys over time have examined the potential for impacts. These studies have shown that sediment transport is predominantly westward and oriented in an east-west direction, aligned with the predominant tidal currents (ENSR, 2005a). Because CSDS lies to the south, impacts to these shellfish beds from dredged material sediment transport from CSDS would be unlikely.

Similar to WLDS and CLDS, short-term impacts to plankton could potentially occur from dredged material entrainment and sediment plumes in the water column at CSDS. A larger area of impact would be expected at CSDS compared to the other sites due to water column depth and the high tidal energy regime of the site.

The location of the CSDS Alternative in the Eastern Basin of Long Island Sound is in deep sand fish habitat near shallow sand and deep transitional habitats. Finfish trawl catch per unit effort data from 1984 to 2000 indicate that of the 24 areas in Long Island Sound sampled, CSDS had the second lowest finfish abundances (EPA, 2004). The depressed levels were not ascribed to placement activity at CSDS as placement was sporadic and species richness was comparable to other areas (EPA (2004), Appendix H-6). It was suggested that the proximity of CSDS to the Long Sand Shoal and Connecticut River outflow negated the habitat advantages of deeper waters (EPA (2004), Appendix H-6). A detailed analysis of direct and indirect impacts to finfish similar to those at WLDS and CLDS has not been conducted at this time.

Placement of dredged material at CSDS would not be expected to cause major alterations to the seafloor habitat over the long term due to dispersal at the site. Minor changes in topography and increased organic matter over the short term could improve demersal fish habitat by creating diversity in seafloor conditions and supporting prey populations.

All of Long Island Sound is mapped as EFH, and there are three listed endangered fish species that potentially could occur at CSDS. There are 10 Federally managed species according to the NOAA EFH square designations. Given that fish are less abundant overall and that fewer EFH species occur, impacts to fish would likely be less than at WLDS and CSDS, and placement at the site is not likely to adversely affect EFH. There could be a greater chance of impacts on the listed shortnose sturgeon and Atlantic sturgeon, as both use the Connecticut River for habitat, than at the other open-water placement alternatives.

About 20 species of marine mammals and reptiles have been identified as possibly occurring at CSDS, which includes five endangered or threatened species of both whales and sea turtles. Open-water placement could potentially impact marine mammals and reptiles, either directly by vessel strikes or indirectly by harassment during dredged material placement due to noise and sediment discharge. Temporary sediment plumes could also cause these creatures to avoid the local area. No habitat at or near CSDS is currently designated or proposed 'critical habitat' in accordance with provisions of the ESA. The potential for vessel strikes is limited by the slow speed of tugboat and barge operations. Recent ship speed reductions have been found to be effective in reducing strikes to whales (Conn & Silber (2013); NOAA (2013)). No strikes to endangered or threatened species or to dolphins and seals are known to have occurred in the history of the DAMOS program. The potential occurrence of endangered or threatened species would be greater at CSDS or NLDS due to proximity to the ocean than at WLDS or CLDS. Potential adverse impacts would be limited and of short duration.

Similar to the other open-water alternatives, there would be intermittent, short-term impacts to water quality from sediment plumes resulting from dredged material placement. At CSDS, water quality impacts would likely be less than those at the other open placement alternative sites due to the rapid mixing and dispersion of suspended sediments given the deeper water column and strong tidal currents. Modeling has indicated that suspended sediments would disperse over a wider area than at WLDS and CLDS. In contrast to the other open-water alternatives, resuspension of dredged material with ambient sediments is also expected to occur with ongoing westward sediment transport at CSDS after placement. This resuspension of sediment could increase short-term turbidity levels in localized bottom waters, however, this would not be significantly greater than ambient conditions in the area.

Long-term impacts on sediment quality would not be likely at CSDS because sediment is typically not confined at the site. Short-term impacts also would not be likely due to sediment testing protocols that do not allow placement of highly contaminated sediments and the generally lower contamination levels of sediments in the harbors and bays of eastern Long Island (Fredette, 2005).

Air quality and noise impacts would likely be short-term and minor, would comply with regulations, and would be within background levels for the area, similar to the other open-water placement alternatives.

Infrastructure Impacts

The open-water placement of dredged material at CSDS would not impact most infrastructure resources (e.g., mooring areas, ports, coastal structures, cable/power/utility crossings, and aquaculture) because these are not present at the site. The temporary transit of barges from harbor regions to and from the alternative site could potentially cause short-term impacts by displacing shipping vessels as well as recreational and commercial vessels at CSDS and/or the transit area. Alteration of bottom depths could also potentially impact navigation. However, navigational channels are not present at CSDS. Moreover, CSDS is a dispersive site, and the management of dredged material placement at the site would ensure that adequate water depths were maintained to minimize impacts to navigation.

Cultural Impacts

No cultural resources (e.g., shipwrecks, archaeology sites, and historic districts) exist at the CSDS Alternative site; therefore, no impacts to these resources would occur. The only potential visual impacts would be of short duration as vessels and barges traveled to and from the alternative site.

New London Disposal Site

Physical Impacts

The NLDS is located south of the mouth of the Thames River and west of Fishers Island. The overall topography of NLDS slopes from a depth of about 46 ft in the north toward the south where depths reach 79 ft (AECOM, 2009). NLDS has similar depths as CLDS but is slightly deeper. A broad trough, or depression, oriented northwest to southeast occurs in the southwest portion of NLDS. The central portion of the trough has been partially filled with dredged material, resulting in an irregular topography. Broad, flat dredged material mounds are a predominant feature at the site, which is managed to maintain a minimum water depth of 46 ft (AECOM, 2009). As long as this depth is maintained, dredged material placement at NLDS would not impact surface waves.

NLDS is located in a complex depositional area where the sediment particle grain size ranges from gravel to silt/clay, with silty fine sand, often with shell fragments dominating much of the seafloor (AECOM, 2009). The dredged material deposited at NLDS has varied from fine-grained sediment to sand, comparable to the range seen at reference areas. Given the predominance of historic dredged material at the site and variability in grain size of ambient sediments in the area, potential impacts to sediment from dredged material placement would be limited due to potential differences in grain size and TOC content (AECOM, 2009).

Diurnal tidal currents tend to be the dominant physical processes that affect sediment transport and deposition at NLDS (Waddell, et al., 2001). Average tidal current speeds are comparable to those seen at CLDS, although observed maximums were higher at NLDS. Recent modeling of circulation in eastern Long Island Sound indicates that NLDS is in an area with relatively low current velocities (O'Donnell, 2014). The increased elevation of the dredged material mounds appears to compound the stress of the tidal currents, resulting in the winnowing of unconsolidated fine sediments (Waddell, et al., 2001). Field evidence indicates that over time, the remaining coarser material and shell fragments at the sediment-water interface result in both an "armoring" layer that protects the area from erosion and a stable deposit (Waddell, et al. (2001), AECOM (2009)).

The location of NLDS with respect to the seafloor topography and nearby land (to the north and northeast, as well as Fishers Island) serves to limit wind-driven waves from the north and east and oceanic swell (Waddell, et al. (2001), O'Donnell (2014)). Although it is exposed to winds from the west or southwest, which blow across the main longitudinal axis of Long Island Sound and are predominant in the summer, these winds do not appear to be strong enough to affect bottom currents or sediments. Strong westerly winds could possibly occur on the backside of a cyclonic storm (hurricane). In recent model simulations of circulation induced by Superstorm Sandy winds, the bottom shear stresses at NLDS were below the threshold to mobilize sediments (O'Donnell, 2014). Therefore, even though much of eastern Long Island Sound had levels above of the threshold and likely experienced sediment disturbance, the modeling indicated that dredged material at NLDS would have remained stable during the storm (O'Donnell, 2014).

Environmental Impacts

Dredged material placement would have similar impacts to those at WLDS and CLDS, with short-term impacts occurring from burial and potential water quality impairment.

Short-term impacts to shellfish from dredged material placement could occur at NLDS. Habitat mapping indicates that the American lobster, blue crab, Atlantic surfclam, horseshoe crab, and softshell clam could occur at NLDS (NOAA, 2014). Surveys in 2000 observed lobster at the site (EPA (2004), Appendix H-7). Dense shell beds of mussels (*Mytilus edulis*) have been documented at both dredged material mounds and reference areas for NLDS, and shell lag is common in the area (AECOM, 2009). Temporary potential impacts include burial and water quality impairments as well as potential benefits from increased variation in topography.

Similar to WLDS and CLDS, t short-term impacts to plankton could potentially occur from dredged material entrainment and sediment plumes in the water column at NLDS.

The location of the NLDS Alternative in the Eastern Basin of Long Island Sound is in shallow transitional habitats influenced by Niantic Bay and deep transitional habitats. No trawlable stations are located near NLDS. Finfish trawl catch per unit effort data from 1984 to 2000 indicate that the nearshore shallow transitional area near NLDS had lower finfish abundances than WLDS and CLDS but greater abundances than CSDS (EPA, 2004). Large catches of scup and butterfish were noted. A detailed analysis of direct and indirect impacts to finfish similar to those at WLDS and CLDS has not been conducted to date. Similar types of impacts from potential burial and respiratory injury, aversion, or displacement due to water quality impairments would be likely.

Placement of dredged material at NLDS would not be expected to cause major alterations to the seafloor habitat. Minor changes in topography and increased organic matter could improve demersal fish habitat by creating diversity in seafloor conditions and supporting prey populations.

All of Long Island Sound is mapped as EFH, and there are three listed endangered fish species that potentially could occur at NLDS. There are 10 Federally managed species according to the NOAA EFH square designations. Given that fish are less abundant overall and that fewer EFH species occur, impacts would likely be fewer than at WLDS and CSDS, and placement at the site is not likely to adversely affect EFH.

About 20 species of marine mammals and reptiles have been identified as possibly occurring at NLDS, which includes five endangered or threatened species of both whales and sea turtles. Open-water placement could potentially impact marine mammals and reptiles, either directly by vessel strikes or indirectly by harassment during dredged material placement due to noise and sediment discharge. Temporary sediment plumes could also cause these creatures to avoid the local area. No habitat at or near NLDS is currently designated or proposed 'critical habitat' in accordance with provisions of the ESA. The potential for vessel strikes is limited by the slow speed of tugboat and barge operations. Recent ship speed reductions have been found to be effective in reducing strikes to whales (Conn & Silber (2013); NOAA (2013)). No strikes to endangered or threatened species or to dolphins and seals are known to have occurred in the history of the DAMOS program. The potential occurrence of endangered or threatened species would be greater at CSDS or NLDS due to proximity to the ocean than at WLDS or CSDS. Potential adverse impacts would be limited and of short duration.

Similar to WLDS and CLDS, there would be intermittent, short-term impacts to water quality at the NLDS Alternative from sediment plumes resulting from dredged material placement. At NLDS, impacts on sediment quality would not be likely for the same reasons dredged material placement would not likely impact the area at WLDS. Several metals do not appear to be in biologically available form, and toxicity test data indicate that sediments are not toxic to amphipods. Bioaccumulation rates for clams, worms, finfish, and lobster were generally in range of levels found in other, non-placement areas of Long Island Sound. Advanced benthic recovery has been documented following dredged material placement. Continued placement of dredged material at NLDS could improve sediment quality at the site.

Air quality and noise impacts would likely be short-term and minor, would comply with regulations, and would within background levels for the area, similar to the other open-water placement alternatives.

Infrastructure Impacts

The open-water placement of dredged material at NLDS would not impact most infrastructure resources (e.g., mooring areas, ports, coastal structures, cable/power/utility crossings, and aquaculture) because these are not present at the site. Navigation channels are present at NLDS. The temporary transit of barges from harbor regions to and from the alternative site would have short-term impacts by displacing shipping vessels as well as recreational and commercial vessels at NLDS and/or the transit area. Discharge of dredged material could also have short-term impacts on submarine transit; a corridor has been established within NLDS to exclude placement in this designated area to minimize potential impacts. Alteration of bottom depths could also potentially impact navigation. However, management of dredged material placement at the site would ensure that adequate water depths were maintained to minimize impacts to navigation.

Cultural Impacts

No cultural resources (e.g., shipwrecks, archaeology sites, and historic districts) exist at the alternative site; therefore, no impacts to these resources would occur. The only potential visual impacts would be of short duration as vessels and barges traveled to and from the alternative site.

Confined Open-Water Placement

Physical Impacts

At the confined open-water site (Sherwood Island Borrow Pit – Site E), the seafloor elevation would be restored to historic depths prior to dredging of the borrow pit. If the physical properties of the cap material were different from the native sediments, placement of material at the site could change the existing sediment grain size and TOC. For example, impacts to sediments would likely occur where native fine-grained sediments were replaced by more granular, sandy material. Placement activities could temporarily increase turbidity and sedimentation surrounding the site. There would likely be no impacts to littoral drift patterns/rates, currents, and waves because the existing depression would be filled to ambient sea floor elevation.

Environmental Impacts

Because a placement pit already exists at Sherwood Island Borrow Pit – Site E, there would be no impacts from construction. Operation (i.e., filling) of the confined open-water alternative would directly impact any bottom-dwelling resources living within the footprint area through direct destruction and/or burial. Resources in the adjacent areas (i.e., the surrounding environment) could potentially be indirectly affected through sedimentation and increased water column turbidity. These impacts would be greatest for sedentary/immobile resources (e.g., benthic infauna and shellfish). Species such as fish and lobster are typically mobile enough to avoid the descending material and could burrow out from beneath a modest thickness of deposited material. It is anticipated that the reduction in diversity and abundance of benthic infauna and shellfish populations within the site would be of short duration. Recovery to levels similar to pre-placement would likely occur within months to several years, as documented at other dredged material placement sites in Long Island Sound in the New England region (Fredette & French (2004), USACE (2012b)). Potential short-term impacts to plankton could occur near the site from entrainment during dredged material placement and temporary decreases in water quality.

The proposed Sherwood Island Borrow Pit – Site E alternative is located in designated EFH. Bottom-dwelling species could potentially occur at this site. Placement operations could potentially change the habitat permanently if sediment that differed from the native material were placed at the site. The placement of suitable dredged material at the site would limit bioaccumulation of any contaminants in the dredged material and would allow a stable benthic community to develop. Although placement of material at this site would cause the permanent loss of water column habitat and decrease habitat diversity, filling the depression to ambient depth could benefit certain fish, shellfish, and other organisms. For example, habitat enhancement for fish and shellfish could potentially occur through an increase in habitat diversity due to bathymetric variations and improved sediment quality.

Federally managed fish species and marine mammals were identified as potentially occurring in the Sherwood Island Borrow Pit – Site E area. These species could experience harassment during operations at the site (USACE, 2012c). There is also the potential for vessel strike impacts from transporting dredged material to the site. However, the same vessel traffic would also create noise and disturb these animals, which would likely deter them from entering the area.

Intermittent, short-term changes in water quality could potentially occur within the residual plumes during and following placement, with a greater potential for water quality impacts under worst-case conditions. Best management practices would limit increased turbidity and the potential for water quality and habitat impairment during placement. The hydrodynamic characteristics (i.e., limited wave action and wave-induced currents) at the site would need to be assessed to ensure that they did not enhance dispersion of dredged material during placement or capping.

Operation activities would create the potential for intermittent, short-term changes in air quality and noise levels, which are anticipated to return to ambient level once placement operations cease.

Infrastructure Impacts

During site operations, potential impacts to recreational resources (boating or swimming) could occur. Vessels and recreational users would be temporarily excluded from the area during operations. However, no designated recreational areas or navigational channels occur at the site. Particle settling during placement operations could potentially deposit sediment at resources adjacent to the CAD cell. Filling the existing depression to the ambient sea floor would have no undermining/erosion impacts to nearby infrastructure resources.

Cultural Impacts

No shipwrecks or other cultural resources occur within the footprint area of the site (USACE, 2012c). Two shipwrecks have been documented shoreward of the site within a half a mile to a mile. There could be a potential indirect impact from increased sedimentation to these resources during the filling of the depression, but this impact would likely be of short duration and would be limited to the immediate vicinity of the site. No historical districts or archeological sites were identified in the nearby area. Because the site would not rise from the seafloor surface, there would be no visual impacts associated with this alternative type.

5.3.2 In-Harbor CAD Cells

Site-specific impacts to the physical, environmental, infrastructure, and cultural resources associated with the in-harbor CAD cell alternative sites have been previously assessed (USACE, 2012c).

5.3.3 Confined Disposal Facilities

Site-specific impacts to the physical, environmental, infrastructure, and cultural resources associated with the CDF alternative sites have been previously assessed (USACE, 2012c).

5.3.4 Landfill Placement

Site-specific impacts to the physical, environmental, infrastructure, and cultural resources associated with the landfill placement alternative site have not been evaluated. General impacts for the placement of dredged material at a landfill site for containment are summarized in USACE (2015a).

5.3.5 Beneficial Use

Site-specific impacts to the physical, environmental, infrastructure, and cultural resources associated with the beach nourishment, landfill capping/cover, Brownfields, and habitat restoration, have not been evaluated. General impacts for the use of dredged material at these alternative sites are summarized in USACE (2015a).

Site-specific impacts associated with the nearshore berm alternative sites have been previously assessed (USACE, 2012d).

5.3.6 Innovative Treatment Technologies

No specific innovative treatment technology alternative sites have been identified for the Long Island Sound study area. If these technologies are to be utilized in the future, an assessment of the associated impacts would need to be conducted on a project-by-project basis.

5.4 CUMULATIVE IMPACTS

The CEQ regulations implementing the procedural provisions of NEPA require Federal agencies to consider the cumulative impacts of a proposal (40 CFR 1508.25(c)). A cumulative impact to the environment is the impact that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR 1508.7). This type of an assessment is important because significant cumulative impacts can result from several smaller actions that by themselves do not have significant impacts.

Cumulative impacts of current and future actions are summarized to determine which alternatives afford the greatest impact or benefit and to allow alternatives to be prioritized for each project. As with the general impacts and benefits discussed in Section 5.1, cumulative impacts are discussed from a qualitative perspective, commensurate with the programmatic level of detail within which this document was developed.

5.4.1 Identification of Cumulative Effects Issues

The first step in developing a cumulative impact analysis in this PEIS was to identify the significant cumulative effects issues associated with the various alternatives analyzed. The relevant NEPA guidance (CEQ, 1997) recommends focusing the analysis on each affected resource, ecosystem, and human community. Therefore, after a review of the generic and site-specific impacts in the Environmental Consequences chapter (Sections 6.1 and 6.3, respectively), cumulative impacts were analyzed for the following resources: physical resources (sediment/soils and waves/currents), environmental resources (benthic invertebrates, shellfish, SAV, MPAs, birds, marine mammals and reptiles, terrestrial and coastal threatened and endangered species, wetlands, air quality, and noise), infrastructure resources, and socioeconomic resources. These resources were identified as having impacts (Section 5.3) for at least one alternative. The remaining resources are not likely to have significant impacts and were therefore not included in the cumulative effects analysis.

Public scoping comments (see Chapter 7) identified the following issues/resources that should be considered in the cumulative impact analysis:

- Concern that most of the dredged material projected to be placed in the Sound for the next 20 years will originate from six Connecticut harbors that contain sediment laced with elevated heavy metals and PCB contamination.
- Concern that lack of dredging will negatively affect employment levels, cost of living, population levels, and quality of life (road congestion and environmental damage) in Connecticut.

- Air quality – increases from increased truck traffic when local ports cannot be used by deep-draft vessels to bring in commodities.
- Economic development– oil movement via barge versus truck, increased truck traffic, economic model used to justify dredging.
- Impacts to adjoining property owners of an upland placement site used for dredged material

5.4.2 Geographic and Temporal Scope of the Cumulative Effects Analysis

The geographic and temporal boundaries of the cumulative effects analysis were expanded to encompass additional effects on the resources, ecosystems, and human communities of concern. The boundaries of the geographic and temporal scopes are described below.

Geographic Scope

The geographic boundaries of the cumulative effects analysis were defined for each type of resource considered. These boundaries allowed for the inclusion of potential impacts from other actions on the resources analyzed. The study area for the cumulative effects for any open-water resources is the Long Island Sound estuary. The study area for the cumulative effects to nearshore and upland resources include the entire study area, which encompasses a portion of the state of New York, all of Connecticut, and a portion of Rhode Island. The cumulative effects study area for air quality impacts is the Long Island Air Basin, which includes the states of New York, Connecticut, and Rhode Island. The cumulative effects study area for the socioeconomic impacts include the entire study area, which encompasses a portion of the state of New York, all of Connecticut, and a portion of Rhode Island

Temporal Scope

For each resource that was considered in the cumulative impact assessment, the temporal boundaries were defined in order to identify past, present, and reasonably foreseeable future actions to be included in the analysis. As described in Chapter 2, since 1977, the USACE, EPA, and the states have evaluated and regulated placement of dredged material in Long Island Sound under the provisions of the CWA amendments to the Federal Water Pollution Control Act and MPRSA. Since 1972, Federal activities and activities of others carried out under Federal permit are subject to review by the states under their CZMA programs. Therefore, the past impacts that are included in the cumulative effects analysis are those that occurred within approximately the last 40 years (i.e., since 1972).

As described in Chapter 1, the planning period for the DMMP is 30 years from the initiation of the DMMP effort. Therefore, 30 years was used as the timeframe for the identification of other reasonably foreseeable future actions (i.e., 2045).

5.4.3 Past, Present, and Reasonably Foreseeable Future Actions

Table 5-3 presents past, present, and reasonably foreseeable future actions that relate to potential impacts to physical, environmental, infrastructure, and socioeconomic resources within the Long Island Sound study area. These actions are considered when determining cumulative actions.

5.4.4 Cumulative Impacts of the No Action Alternative

Under the No Action Alternative, the option of dredged material placement at a designated open-water placement site would no longer be available. The scenarios that would result from 'No Action' (described in Section 5.2) vary, from continued dredging and placement of materials at multiple selected open-water sites or nearshore/upland locations within the Long Island Sound area to no dredging at all. Cumulative impacts to physical, environmental, infrastructure, and socioeconomic resources from the various No Action scenarios are described below by resource.

Physical Resources

As described in Section 5.2, sedimentation and erosion could increase because sediment could be dispersed over a greater area within or outside of Long Island Sound under the No Action Alternative. Climate change resulting in sea level rise and increased storm activity could have a greater impact on beach loss and erosion, which could lead to increased damage to shoreline and nearshore alternative sites and increased sediment transport. Increased shoreline protection could occur in areas where nourishment or restoration alternatives are located. However, the volume of sediment being deposited in the Sound from the three large rivers that empty into the Sound (Connecticut, Thames, and Housatonic) is much larger than the volumes that would be placed in the Sound through dredging. Therefore, under some scenarios of the No Action Alternative, significant impacts on the physical resources in Long Island Sound would not be expected given the scale and magnitude of other regional events. If dredging were limited or did not occur, the accumulation of naturally deposited sediment could cause shoaling in rivers and harbors, resulting in decreased water depths and potential changes in nearshore hydrodynamics.

Environmental Resources

Non-dredging events (vessel traffic incidental discharges, particulate emissions, spillage, and accidents) and watershed-wide contaminant loading from agricultural, urban, and industrial sources continue to stress the Long Island Sound sediment environment, particularly in the Western Basin. Under the No Action Alternative, future dredged material that passed quality standards for unconfined placement would be restricted to approved areas with a relatively small footprint, either inside or outside the Long Island Sound basin, so that sediment quality impacts could be limited. However, an increase in the number of selected placement sites could extend the overall placement footprint and increase impacts to sediment quality. Non-dredging events (vessel-related contamination) and watershed-wide contaminant loading from agricultural, urban, and industrial sources would continue to dominate the inventory of stressors. The potential cumulative Long Island Sound sediment quality effects resulting strictly from placing dredged material that meets quality standards in the Sound, at sites elsewhere, at additional selected sites, or in confined areas are considered to be minor compared to the other sources of contaminants around the Sound. Decreased dredging, which could result under the No Action Alternative, coupled with contaminant loading from point and non-point sources, could potentially result in decreased sediment quality at harbor and river locations.

Table 5-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
Physical Resources			
Sediments (including sand)	It is estimated that more than 37 million CY of material may have been placed throughout Long Island Sound between 1941 and 2014. Runoff from CT rivers has brought silt, sediments, and sand to Long Island Sound since they first began flowing into the Sound. Sand has also been placed throughout various beach, shoreline, and open-ocean site locations. Large storms have moved sediment, sand, and silt throughout Long Island Sound.	Distinct placement mounds from current dredged material placement at designated unconfined open-ocean disposal sites have formed. Depending on the source type of material and the placement location, a change in grain size and TOC could occur. Runoff from CT rivers brings silt and sediments to Long Island Sound. Direct runoff from land to Long Island Sound occurs from storms (NY and CT). Large storms will continue to move sediments, soils, and sand around Long Island Sound.	Projects currently approved and funded for dredging and dredged material placement will continue. CT rivers will continue to deposit silt and sediment into Long Island Sound. Waves from strong storms will continue to move silt, sediment, and sand from land masses throughout Long Island Sound into the waters of the Sound. This movement could increase due to climate change and sea level rise.
Currents/ Waves/ Littoral Drift	Changes to coastal areas due to storms, currents, and waves; sea level changes; and man-made alterations of the coastline have influenced littoral drift in some areas.	Changes to coastal areas due to storms, currents, and waves; sea level changes; and man-made alterations of the coastline are influencing littoral drift in some areas.	Changes to coastal areas due to storms, currents, and waves; sea level changes; and authorized man-made alterations will influence littoral drift in some areas in the future.
Environmental Resources			
Sediment Quality	In the distant past, sediments with a range of potential contaminants moved down watershed rivers and into the Long Island Sound basin or were placed there without regulation. Since passage of the CWA and other environmental laws, contaminant loading to sediments has declined, contaminated sediment placement restrictions have been established, and the	All dredged material considered for placement in Long Island Sound is evaluated for quality following the criteria established by EPA (40 CFR 227 & 228). Dredged material that passes the criteria is placed either in unconfined locations or in nearshore or upland locations, while material that does not pass the criteria is placed in confined areas. Sediment quality hasgenerally	Projects currently approved and funded for dredging and dredged material placement will continue. Designation of a dredged material disposal site is likely in eastern Long Island Sound. Watershed rivers will continue to deposit silt, sediment, and associated contaminants into Long Island Sound. In addition, some level of continued contaminant loading is anticipated from point

Table 6-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
Sediment Quality (cont.)	quality of dredged sediments placed in Long Island Sound has improved. MPRSA Section 106(f) requires that all material considered for Long Island Sound placement meet quality criteria established by EPA (40 CFR 227 & 228). In the recent past, dredged material that passed the criteria was normally placed in unconfined locations, while material that did not pass the criteria was placed in confined areas.	improved due to stricter screening of dredged material for placement and due to general control of pollution in the watershed. However, watershed rivers and runoff continue to deposit silt, sediment, and associated contaminants into the Long Island Sound basin. Various local and regional programs that may reduce the volume of sediment carried by stormwater and runoff from the states within the watershed have been developed (Appendix E).	and non-point sources, including river and runoff sediment loads. Programs designed to reduce volumes of sediment entering into Long Island Sound will continue.
Bioaccumu-lation Potential	Trends in tissue concentrations have been monitored for many years through various local, regional, and national programs. Tissue concentrations have been found to be variable over the past 40 years, with some contaminants showing marked decreases in some organisms over time. Spatially, tissue concentrations have generally been found to be higher in the western portion of Long Island Sound compared to the eastern portion. Overall, direct correlation with sediment concentrations has been weak.	All dredged material considered for placement in Long Island Sound is evaluated for quality, including an assessment of bioaccumulation potential. Dredged material that passes the criteria is normally placed in unconfined locations, while material that does not pass the criteria is placed into confined sites. Tissue concentrations in various organisms continue to be monitored by existing local, regional, and national programs. Watershed rivers continue to deposit silt, sediment, and potential contaminants with bioaccumulation potential into the Long Island Sound basin.	Bioaccumulation potential from open-water placement will continue to be measured as a requirement for placement permits. Tissue concentrations in various organisms will continue to be monitored by existing local and national programs. Watershed rivers will continue to deposit silt, sediment, and associated contaminants into Long Island Sound and some level of continued contaminant loading and associated bioaccumulation potential is anticipated from point and non-point sources, including river sediment loads.

Table 6-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
Water Quality	In the past, water quality was impacted by releases of various pesticides, chemicals, and untreated human waste into the environment. However, since the implementation and constant updating of environmental regulations, water quality has improved. In recent years, hypoxia has been an issue in Long Island Sound due to the excess nutrients carried by CT rivers into Long Island Sound. The amount of hypoxia experienced in Long Island Sound in a particular year varies.	Federal regulations control releases of chemicals and wastewaters into the environment. The TMDL for nitrogen in Long Island Sound was developed in 2000 as a management tool to decrease nutrient loading and improve DO concentrations in the sound (NYSDEC and CTDEP, 2000). Federal grants are being obtained to develop programs to decrease the level of excess nutrients that Long Island Sound receives. Localized sediment plumes occur during dredged material placement, resulting in short-term and localized increases in turbidity and the potential for a localized, short-lived source of nutrients and other anthropogenic compounds to the water column.	The nitrogen TMDL will lead to reduced levels of eutrophication in the Sound. Additional focus on non-point nutrient sources will further enhance the success of these water quality improvement measures. Climate change will lead to higher sea level, potentially more severe and frequent storms, and additional precipitation/runoff in the region. Climate change is also leading to an overall increase in acidity in the world's oceans. Ocean acidification will likely exacerbate eutrophication in coastal waters by reducing pH even further, potentially impacting shellfisheries, benthos, phytoplankton, and other aspects of the ecosystem. It is unclear how these climate changes will impact the effectiveness of resource management actions to reduce nutrient inputs to Long Island Sound. Any impacts on water quality due to future population growth and development in the region should be mitigated by aspects of the TMDL and be limited.
Benthic Invertebrates	Natural and anthropogenic stressors on benthic habitats in Long Island Sound include physical (storms and dredged material placement) and chemical disturbances (anoxia, contamination, and acidification). Short-term reductions in abundance and diversity were observed at all dredged material placement sites; however, when sediment characteristics	Natural and anthropogenic stressors on benthic habitats in Long Island Sound include physical (storms and dredged material placement) and chemical disturbances (anoxia, contamination, and acidification). Short-term reductions in abundance and diversity occur at all dredged material placement sites, but when sediment characteristics are similar at both the	Short-term reductions in abundance and diversity from future dredged material placement in eastern Long Island Sound and existing open-water placement locations is expected. However, recovery to abundance and species diversity similar to pre-placement levels are expected, though possibly delayed or prevented when sediment characteristics at the placement location are different from the

Table 6-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
	were similar at both the dredging location and the placement location, recovery to abundance and species diversity similar to pre-placement levels were documented. Changes in abundance and species diversity occurred where dredged sediment characteristics were different from native material at the placement site	dredging location and the placement location, recovery to abundance and species diversity similar to pre-placement levels is expected. Changes in abundance and species diversity occur where dredged sediment characteristics are different from native material at the placement site.	dredging location. Future changes in benthic invertebrates due to sea level rise and climate change are possible based on changes in overall depth in various locations; the potential for changes in temperature; and increased storm activity, acidity of seawater, and runoff (sedimentation).
Shellfish (not including leased areas)	In the past, there have been decreases in shellfish populations attributed to disease, contamination, overfishing, and possibly loss of optimal habitat due to increased nearshore water temperatures.	Commercially important species of shellfish continue to be fished. Changes in ocean temperatures increase the likelihood of disease and habitat alteration. There has been a noted decrease in overall levels of contaminants in sediments and water, decreasing the potential for contaminants in shellfish.	Commercially important species of shellfish will continue to be fished. Changes in ocean temperatures and sea level rise will increase the potential for disease and habitat destruction. Decreases in overall levels of contaminants in sediments and water will decrease the potential for contaminants in shellfish. Future changes in shellfish due to sea level rise and climate change are possible based on changes in overall depth in various locations; the potential for changes in temperature; and increased storm activity, acidity of seawater, and runoff (sedimentation).
Federally Managed Species	Many environmental and man-made activities have caused a decrease in habitat and populations of some Federally managed species. Implementation of environmental regulations banning or limiting the use of contaminants in the environment has resulted in population increases for some Federally managed species. Being aware of migration patterns, mating/nesting areas, foraging areas, etc.	Changes in populations of Federally managed species (increases and decreases) are occurring for a variety of reasons, including climate change, sea level rise, and habitat change. Currently, regulations are in place to prevent the dredging and placement of material when and where Federally managed species are present. Being aware of migration patterns, mating/nesting areas, foraging areas, etc, and creating dredging	Regulations will remain in place to prevent the disturbance of Federally managed species. Being aware of migration patterns, mating/nesting areas, foraging areas, etc. and creating dredging windows will continue to minimize impacts to Federally managed species. Climate change and sea level rise may cause changes to habitats.

Table 6-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
	and creating dredging windows have collectively worked to minimize impacts to Federally managed species.	windows continues to minimize impacts to Federally managed species.	
SAV (eelgrass)	Fragmentation and overall decrease in SAV resources have occurred due to development, damage from fishing activities, disease, and reduction in coastal water quality. SAV conservation efforts within the study area have included improving coastal water quality, limiting development in SAV beds, and implementing replanting programs.	Development and impaired coastal water quality continues to adversely impact SAV beds in the study area. SAV conservation efforts include improving coastal water quality, limiting development in SAV beds, and implementing replanting programs.	Increase in sea level and ocean temperatures and continued coastal development provide the potential for additional impacts to SAV. Focused conservation efforts provide the potential for SAV restoration within the study area.
Marine Protected Areas	MPAs were established within the study area in the early 2000s to conserve marine resources, and locations were identified and protected.	At this time, additional protections being instituted in this area are unknown.	Additional MPAs could be identified and additional protections could be put in place, but none are currently known.
Birds	Coastal development and other environmental and human activities have caused a decrease in habitat and populations of some species of waterfowl, colonial waterbirds, and endangered and threatened species. Implementation of environmental regulations banning or limiting the use of contaminants in the environment has resulted in population increases for some endangered and threatened species	Changes in species populations of birds (increases and decreases) are occurring due to climate change, sea level rise and habitat change. Currently, regulations are in place to prevent the dredging and placement of material when and where endangered and threatened birds are present.	Human activity and coastal development will continue. However, regulations will remain in place to prevent the disturbance of endangered and threatened species. Climate change and sea level rise may cause changes to habitat.
Marine Mammals & Reptiles	Coastal development, shipping, whaling, and other environmental and human activities have impacted marine mammals and reptiles and their habitats in the past.	Impacts to marine mammals and reptiles continue to occur. Current regulations are in place to prevent the dredging and placement of dredged material when and where marine mammals and reptiles are present during	Human activity and coastal development will continue; however, regulations will remain in place to prevent the disturbance of marine mammals and reptiles. Climate change and sea level rise may cause changes to habitat.

Table 6-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
		specific life events (i.e., foraging areas, migration patterns, etc.).	
Wetlands	Fragmentation and overall decrease in wetland function has occurred due to development, decreased water quality, and introduction of invasive species. Wetland restoration has occurred in some portions of the study area.	Colonization of invasive species and impairments to water quality continue to impact wetland communities. Damage due to storms or environmental releases (i.e., water-based oil spills) is a threat to wetland resources. Conservation efforts are protecting and restoring wetlands within the study area.	Colonization of invasive species and changes in sea level, temperature, and water quality could result in impacts to wetland communities. Damage due to storms or environmental releases (i.e., water-based oil spills) could also result in changes to wetlands. Conservation and restoration efforts have the potential to increase wetland resources and functions.
Federal & State Listed Species (Terrestrial and Coastal)	Losses or changes in habitat, impaired water quality, and application of chemical pesticides have caused a decrease in the habitat and populations of some terrestrial species, leading to them being protected at the Federal or state level.	Habitat fragmentation and impaired water quality continue to impact threatened and endangered species. Protection under Federal and state programs reduces this impact, and some populations have stabilized.	Climate change may impact Federal and state-listed species. Regulations will remain in place to prevent further disturbance to the habitat of endangered and threatened species.
Air Quality/ Noise	Increased urbanization and development has resulted in increased noise in surrounding areas and adverse effects on regional air quality.	Noise and air pollution from urban settings will continue. As dredging projects are authorized, noise and air pollution increase due to the use of dredges and tugs. Where upland placement is used, noise and air pollution from land-based sources also increases.	Future dredging and dredged material placement activities will continue to have adverse noise and air quality impacts.
Infrastructure Resources			
All Infrastructure Within the Study Area	Coastal infrastructure (e.g., mooring areas, navigation channels, ports, coastal structures, cable/power/utility crossings, recreational areas, aquaculture, dredged material alternative sites) and upland infrastructure (e.g., roads, railways,	Current infrastructure is growing and constantly being updated to meet the growing demands of an urbanized area. Dredging continues to maintain critical navigation routes. However, recent storms and resulting flooding have caused significant damage to	Dredging to maintain critical infrastructure is expected to continue. Concern for climate change and sea level rise will prompt Federal, state, and local agencies and private parties to consider measures to protect and provide resiliency to coastal communities,

Table 6-3. Past, Present, and Reasonably Foreseeable Future Actions for the PEIS Cumulative Impact Analysis.

Resource	Past Actions	Present Actions	Future Anticipated Actions
	bridges) have been generally well established during the previous 40 years. Dredging activities often supported maintenance of these structures and of areas such as navigational dredging and dredging of ports and harbors.	many existing structures and impacted much of the coastal infrastructure. In light of these recent events, guidance on rebuilding coastal infrastructure was recently published (NOAA and USACE, 2013).	with strategies to manage risk to vulnerable populations, property, ecosystems, and infrastructure (USACE, 2015b).
Socioeconomic Resources			
Socioeconomic Resources Within the Study Area	The shores of Long Island Sound have been transformed since the second half of the 20th century by widespread suburbanization, urban renewal, and commercial and corporate development.	Long Island Sound is located within the most vibrant economic region for commerce in the nation. The study area encompasses one of the most densely populated and industrialized regions in North America. There are over 15.2 million persons, over 430,000 businesses and 6.1 million employees, and nearly 400 identified ports within the Long Island Sound study area. Long Island Sound provides open-water access to commercial navigation, commercial and recreational fishing, strategic military operations, and tourism. The contribution of navigation-dependent activity to GSP within the Long Island Sound region is approximately $9.4 billion per year and represents 0.93% of the study area's overall GSP.	Based on historical trends, population growth in the Long Island Sound study area is projected to increase 0.2% between 2010 and 2030. Any expansion of economic activity reliant upon the resources available from Long Island Sound may add pressure for increased utilization. Designation of a dredged material placement site in eastern Long Island will provide a viable placement alternative for nearby dredging projects. Long Island Sound will continue to contribute to the diversity of the regional economy, but tradeoffs for resource use may be necessary to accommodate demand.

Water quality impacts associated with climate change—including increased severity and frequency of storms in the northeast, sea level rise, ocean acidification, and increased runoff—appear to be much more substantial compared to impacts associated with the various No Action Alternative scenarios. Increased placement at upland locations could impact terrestrial and riverine water quality.

Benthic invertebrates could experience increased impacts through climate change, sea level rise, and increased dispersion of dredged material if additional sites were selected within Long Island Sound. If dredged material were repeatedly placed at a given location, recovery of benthic invertebrates could be reduced or delayed. The recruitment of benthic invertebrates to a disturbed site could be negatively impacted if placement occurred at multiple sites within the same geographic area, including potential alteration of community as a result of changes to habitat type (grain size) and food resources. However, dredging-related impacts are not expected to be significant compared to impacts associated with climate change.

Shellfish could experience increased impacts through climate change, sea level rise, and increased dispersion of dredged material if additional sites were selected within Long Island Sound. Susceptibility could increase due to parasites and compromised immune systems because of environmental changes in water temperature. If dredged material were repeatedly placed at a given location, recovery of shellfish species present could be reduced or delayed. The recruitment of shellfish species to a disturbed site could be negatively impacted if placement occurred at multiple sites within the same geographic area, including potential alteration of community as a result of changes to habitat type (grain size) and food resources. However, dredging-related impacts are not expected to be significant compared to impacts associated with climate change.

Atlantic sturgeon and several species of turtles are the Federally managed species most likely to be found in Long Island Sound. Changes to food resources and habitat, either adverse or beneficial, could affect some Federally managed species during particular behaviors, such as migration, spawning, foraging, and schooling. If additional sites were designated or selected within Long Island Sound, dredged material placement activities could increase turbidity and impair water quality and habitat. Potential issues from vessel strikes and/or harassment due to noise could also deter species from entering the area. Federally managed species could also experience increased impacts through climate change and sea level rise, including potential alteration of community as a result of changes to habitat type (grain size) and food resources. However, dredging-related impacts are not expected to be significant compared to impacts associated with climate change.

SAV and wetlands could experience increased impacts through climate change, impaired water quality, and increased placement of dredged material at coastal sites in Long Island Sound. If dredged material were repeatedly placed at a given location, recovery of SAV resources could be reduced or delayed. If open-water placement is limited, additional nearshore and shoreline placement sites could be required in order to meet placement needs and could result in increased nearshore placement. Sea level rise could also alter habitat and impact SAV resources.

If open-water placement is limited, additional nearshore and shoreline placement sites could be required in order to meet placement needs. This could increase impacts to birds and other Federal and state-listed species and could increase impacts to existing or new MPAs. However, some nearshore placement could also create new habitat and provide benefits, including protection from wave energy, creation of bird feeding and nesting habitat, and enlargement of a coastal MPA. Bird species could also experience increased impacts through climate change, sea level rise, and increased dispersion of dredged material if additional sites were selected within Long Island Sound.

Cumulative impacts to marine mammals and reptiles could occur from climate change and sea level rise, which could result in potential alteration of community as a result of changes to habitat type (grain size) and food resources. If additional sites were selected within Long Island Sound, dredged material placement activities could alter habitat, increase turbidity, and impair water quality and habitat.

Present and future urbanization-related activities in upland areas and activities in Long Island Sound under No Action Alternative conditions would have cumulative and adverse effects on air emissions and noise. However, these cumulative effects are not likely to be significantly different from existing conditions.

Infrastructure

As seen from recent historic storms, impacts from climate change and sea level rise have caused significant damage to many existing structures and have affected much of the coastal infrastructure within Long Island Sound. These impacts are regional in scale and much larger in magnitude than anticipated impacts from dredging-related activities. Decreased dredging, in combination with increased runoff and sedimentation as a result of climate change and sea level rise, could result in increases in shoaling, which would have negative impacts to recreational and commercial vessels.

Socioeconomic Resources

Continued growth in the region is expected to result in an increased demand for goods and shipping-related needs. The cumulative impacts of delayed or abandoned dredging of Long Island Sound's waterways would likely affect those regional economic enterprises (and the associated employment) that depend on Long Island Sound for reliable access to water resources and transportation. In the absence of a DMMP, local ports would compete for limited dredging funds at a higher unit cost while attempting to maintain economic viability. As time passed, with limited maintenance of existing channels, market forces would likely create alternatives to existing marine transportation activity and other uses of the Sound, with a projected decrease in Long Island Sound's overall contribution to the regional economy.

5.4.5 Cumulative Impacts of the Placement Alternatives

This PEIS evaluates the following types of potential dredged material placement alternatives: unconfined open-water placement, confined open-water and nearshore placement, upland placement, and various beneficial use alternatives. Cumulative impacts would vary depending on the type of alternative chosen. Any cumulative adverse impact to Long Island Sound's physical, environmental, infrastructure, or socioeconomic resources could diminish its value for commercial and recreational uses; however, the short-term impacts observed to date under the alternatives considered (discussed in Section 5.3) have been shown to be temporary and have not resulted in significant unacceptable adverse impacts to Long Island Sound. Potential cumulative impacts covering the range of placement alternatives are described below by resource.

Physical Resources

The overlap of multiple open-water dredged material placement events would ultimately build discernible mounds, altering the topography of the area ranging from increases of several inches to several feet. Accumulations would be monitored at designated sites to limit mound heights to depths that would not restrict navigation. Minimal alterations of bottom currents could also occur; however, these are not known to interfere with regional circulation. Bottom currents and topography alterations at nearshore placements sites (i.e., berms) could have more localized impacts to both navigation and circulation. Any sedimentation impacts from dredged material plumes would likely occur close to placement sites and would be very small compared to the total sedimentation rate of Long Island Sound. Beneficial impacts of nearshore placements would include reducing shoreline erosion; stabilizing beaches and saltmarsh wetlands; and importing organic matter to (and covering historic dredged material at) deep-water designated sites. Impacts to currents, waves, or littoral drift would likely be localized and small relative to Long Island Sound and its hydrodynamics. CDFs typically change the shoreline and the nearshore sea floor elevation, thereby altering wave energy regimes; therefore, littoral drift patterns/rates, currents, waves, and sediment transport would be impacted as the CDFs are filled to elevations above mean sea level. There is the potential for increased tidal channelization in nearshore areas and changes to flow rates and wave action. Beneficial impacts would include reducing nearshore wave and current action and reducing shoreline erosion. Impacts from climate change and sea level rise need to be considered when siting alternative placement locations. Rising seas and increasing storms could have similar if not greater impacts on the physical conditions of nearshore and shoreline areas.

Environmental Resources

Cumulative impacts related to sediment quality and bioaccumulation from open water and nearshore placement would likely be minor and temporary. Potential CDF transfer losses with bioaccumulation potential are expected to be minimal; CDF designs/specifications would address effluent discharges and pre-treatment would be instituted as needed. Material placed at Brownfield or mine reclamation sites would be required to meet site-specific design and quality requirements and would be managed on a case-by-case basis. Non-dredging events (vessel-related contamination) and watershed-wide contaminant loading from agricultural, urban, and industrial sources would continue to dominate the inventory of stressors. The potential cumulative Long Island Sound sediment quality effects resulting strictly from placing dredged material that met quality standards in the Sound, at sites elsewhere, or in confined areas would likely be short-term and minor.

Impacts to water quality from dredged material placement at open-water and nearshore sites are generally short-term and localized. Impacts from runoff from confined placement alternatives, including landfills, are generally tightly regulated and can be treated if required to limit water quality impacts. Water quality impacts from other regional sources, including agricultural, industrial and urban runoff, and from the effects of climate change and sea level rise, would likely be more significant, far-reaching, and long term.

Impacts to benthic and shellfish communities and habitats from dredged material placement would likely be localized and temporary (months to several years). However, if dredged material were repeatedly placed at a given location, the habitat characteristics could change and recovery of these organisms could be reduced or delayed. If placement occurred at multiple sites within the same geographic area, the recruitment of benthic invertebrates to a disturbed site could be negatively impacted. The estimated annual average dry weight of dredged material placed in Long Island Sound is less than half of the annual sedimentation rate from rivers to the Sound (SAIC, 1994). Also, the surface area of open-water and nearshore alternative sites is small compared to the overall area of Long Island Sound. The cumulative impacts to benthos are likely to be caused by natural factors (such as susceptibility to parasites and compromised immune systems because of environmental changes in water temperature due to climate change) as well as man-made stressors, including watershed-wide contaminant loading from agricultural, urban, and industrial sources.

Atlantic sturgeon and several species of turtles are the Federally managed species most likely to be found in Long Island Sound. Dredged material placement activities could increase turbidity and therefore change (impair or enhance) these species' food resources and habitat. These changes could also affect some Federally managed species and other marine mammals during particular behaviors, such as migration, spawning, foraging, and schooling. There could be potential issues from vessel strikes and/or harassment due to noise, which could also deter species from entering the area. Impacts related to climate change and sea level rise could occur as well.

Impacts to SAV beds and wetlands from dredged material placement would likely be localized and temporary. However, if dredged material were repeatedly placed at a given location, recovery of the resource could be reduced or delayed. The surface area of coastal and upland alternative sites is small compared to the overall study area, and many of these sites were selected in part due to the degraded condition of the site and lack of sensitive resources. Therefore, it is likely that impacts from climate change, sea level rise, and invasive species would be more widespread and permanent than impacts from dredged material placement.

Impacts to existing or new MPAs over time are possible. However, some nearshore placement could also create new habitat and provide benefits, including protection from wave energy, creation of bird feeding and nesting habitat, and enlargement of a coastal MPA. Cumulative impacts could occur from climate change, sea level rise, and impaired coastal water quality.

Impacts to birds from dredged material placement would likely be localized and temporary. However, if dredged material were repeatedly placed at a given location, historic avian nesting locations could be abandoned. Changes (increases and decreases) in species populations of birds are occurring for a variety of reasons other than dredging and dredged material placement, including climate change, sea level rise, and habitat change due to both environmental and man-made influences.

Impacts to threatened and endangered species from dredged material upland placement would likely be localized and temporary. However, if dredged material were repeatedly placed at a given location, recovery of the resource could be reduced or delayed. The surface area of upland alternative sites is very small compared to the overall study area, and many of these sites were selected in part due to the degraded condition of the site and lack of sensitive resources. Therefore, it is likely that impacts from climate change and habitat fragmentation would be more widespread and permanent than impacts from dredged material placement.

Continued urbanization within the affected environment of the Long Island Sound study area, especially in nearshore and upland areas, is likely and could cumulatively contribute to the effects on air quality and noise from the proposed placement alternatives, particularly for upland placement options. The degree of additive impacts resulting from the proposed alternatives would likely be low, in part because the sources of air emissions and noise under the placement alternatives are not likely concentrated or located in close proximity to sensitive land areas or receptors; therefore, the alternatives would not be likely to violate ambient air quality standards or result in significant noise impacts.

Infrastructure

As seen from recent historic storms, impacts from climate change and sea level rise have caused significant damage to many existing structures and have affected much of the coastal infrastructure within Long Island Sound. These impacts are regional in scale and much larger in magnitude than anticipated impacts from dredging-related activities.

Socioeconomic Resources

Under the proposed placement alternatives, the cumulative impact on socioeconomic resources would be continued reliability of the Long Island Sound waterway system to provide for resource utilization and reliable waterway transportation. Marine transportation, recreational boating, and the Naval Submarine Base account for the majority of the impact of navigation-dependent activities on regional output, GSP, employment, and tax revenue within the Long Island Sound study area (USACE, 2010). By focusing on water placement in designated, well-defined areas within the Sound as well as utilizing other placement alternatives, impacts to environmental resources would be minimized and the use of Long Island Sound for commercial and recreational consumption would be preserved. Beach creation/nourishment from berm placement could contribute to long-term recreational benefit to the region.

Summary

Overall, urbanization, climate change, and sea level rise would likely impact the various resources in Long Island Sound on a much larger scale and with greater magnitude than would dredged material placement activities. Cumulative impacts for each project-specific alternative would need to be analyzed in the future as part of the planning and permitting activities for specific dredging projects.

5.5 MITIGATION

Mitigation needs must be considered as part of an EIS. With regard to this PEIS, mitigation can be addressed only in general terms because the details of most of the actual dredging projects have not been developed at this time. When those projects are developed, specific mitigation strategies and practices will be addressed as part of the permitting process.

Mitigation is defined in CEQ regulation 40 CFR 1508.20 (a-e) as:

> (a) Avoiding the impact altogether by not taking a certain action or parts of an action.
> (b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
> (c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
> (d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.
> (e) Compensating for the impact by replacing or providing substitute resources or environments.

Generally accepted mitigation strategies related to the various resources potentially impacted by the alternatives considered in this PEIS are described below.

Impacts from the creation of mounds due to offshore placement and/or berm creation can be avoided or mitigated through notices to mariners and through other site management practices.

Many potential environmental impacts from dredged material placement in water can be avoided by limiting dredging and placement to specific times of the year when disturbance to species migration or spawning may be avoided. In addition, material placement can be 'sequenced' to ensure that the type of material (e.g., grain size) placed at the surface closely resembles ambient material contiguous to the site; this practice can support natural recovery and ensure that communities are minimally impacted. While there may be minimal short-term impacts to fish and benthos (principally the burial of limited portions of in-water placement sites), these impacts can sometimes be limited by the infrequent, temporary and seasonally restricted nature of the placement operations. Short-term impacts to benthos from burial can be mitigated by recolonization and the targeted creation of placement mounds. Water quality impacts from offshore placement can be modeled and generally show very localized and short-term occurrences. These can also be mitigated through site management practices.

A number of management techniques can eliminate or minimize adverse direct physical and environmental impacts resulting from construction of CDFs (EPA and USACE, 2004). These techniques include dewatering dredged material to reduce volume; treating effluent; removing material from the CDF for some beneficial use, thereby restoring the capacity of the CDF and reducing the need for larger or additional sites; creating alternative habitat; and improving site aesthetics by landscaping and/or installing screens when warranted.

Various construction techniques can mitigate and minimize impacts from CAD cells. The thickness of the sediment cap (where necessary), the equipment and dredging techniques selected, and the placement schedule with respect to tidal currents can minimize water quality impacts under the CAD cell alternative. Environmental monitoring during placement can also mitigate impacts under this alternative.

Impacts to nearshore and upland water quality from confined placement and landfill placement can generally be avoided through strict regulatory monitoring of effluent and runoff to meet water quality standards.

In general, impacts to infrastructure resources (e.g., mooring areas, navigation channels, ports, coastal structures, cable/power/utility crossings, recreational areas, aquaculture, and dredged material alternative sites) from offshore or nearshore placement, including CDFs, are not anticipatedbecause the selected sites for these alternatives would avoid coastal areas where ports or other marine structures are present.

Under the No Action Alternative, adaptive behavior will likely occur to mitigate impacts to markets if dredging in the Sound's waterways is reduced. As time passes with limited maintenance of existing channels, market forces will rely on alternatives to existing marine transportationactivity and other uses of Long Island Sound, with a projected decrease in the Sound's overall contribution to the region's economy.

To mitigate socioeconomic impacts from open-water placement, lobstermen and other fishermen can be notified prior to dredging operations, and barges and scows can use short tow lines to minimize dragging which can damage lobster pots in the project area. To mitigate socioeconomicimpacts to other fishery-related resources, dredging and placement activities can be deferred during key life-cycle events for these species, and dredged material placement sites can be situated at locations where sensitive spawning grounds or habitats are not present.

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